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March 12, 1985

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Hand Delivered, March 6, 1985
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Re: United States, et al. v. Reilly Tar & Chemical Corporation, et al.
File No. 4-80-469

Dear Counsel:

Enclosed please find Reilly Tar & Chemical Corporation's Supplemental Response to the United States' Interrogatories and Requests for the Production of Documents.

Very truly yours,

Mark R. Kaster

Mark R. Kaster

MRK/am

90-7-1-21

MAR 14 1985

LANDS

UNITED STATES DISTRICT COURT
DISTRICT OF MINNESOTA
FOURTH DIVISION

UNITED STATES OF AMERICA,

Plaintiff,

and

STATE OF MINNESOTA, by its Attorney General Hubert H. Humphrey III, its Department of Health, and its Pollution Control Agency,

Plaintiff-Intervenor,

v.

REILLY TAR & CHEMICAL CORPORATION; HOUSING AND REDEVELOPMENT AUTHORITY OF ST. LOUIS PARK; OAK PARK VILLAGE ASSOCIATES; RUSTIC OAKS CONDOMINIUM, INC.; and PHILLIP'S INVESTMENT CO.,

Defendants,

and

CITY OF ST. LOUIS PARK,

Plaintiff-Intervenor,

v.

REILLY TAR & CHEMICAL CORPORATION,

Defendant,

and

CITY OF HOPKINS,

Plaintiff-Intervenor,

v.

REILLY TAR & CHEMICAL CORPORATION,

Defendant.

Civil No. 4-80-469

REILLY TAR & CHEMICAL CORPORATION'S SUPPLEMENTAL RESPONSE TO THE UNITED STATES' INTERROGATORIES AND REQUESTS FOR THE PRODUCTION OF DOCUMENTS

The following supplemental interrogatory and document production responses are submitted following several Local Rule 4(c) conferences between Reilly and the United States regarding certain aspects of Reilly Tar & Chemical Corporation's Response to the United States' Interrogatories and Requests for the Production of Documents, which response is dated December 20, 1984. Each of these responses is submitted as a supplement for Rule 4 purposes and without waiving any objections previously asserted.

SUPPLEMENTAL RESPONSE TO INTERROGATORIES 6, 7 and 8:

Reilly supplements its prior responses by referring plaintiff to a memorandum dated March 23, 1971 from R. J. Hennessy to P. C. Reilly, bearing document numbers 303233-40 for a narrative summary of waste disposal at Reilly's various plants as of that date.

The following narrative summaries of practices at Reilly's currently operating coal tar refineries are provided:

CLEVELAND

RCRA

The Cleveland plant presently has interim status under Permit #OHD083320945 to generate and store hazardous waste in piles and drums. The interim status permit application was made on November 18, 1980. Part B has not yet been called in. Reilly also has an Ohio Hazardous Waste Facility Permit #02-18-0574. In 1983, 182 yards of material were disposed of off site and in 1984, 155 yards were disposed of off site. All off site disposal was placed in an RCRA permitted facility.

WATER

Process waste water is treated by passing through a primary separating tank then through an API type separator and finally through a straw filter prior to discharge to the Cleveland sanitary sewer. The primary separating tank contains an oil sensing probe which will automatically shut off the flow and sound an alarm if the presence of creosote oil is sensed in the discharge to the API separator. This is to sense overloading of the system and prevent free creosote oil from being discharged to the sanitary sewer.

AIR

Reilly presently has permits covering all regulated emission sources, counter flow water scrubbers and vapor knockout tanks control emissions from pitch tanks, truck and RR car loading stations, cleaning stations and batch still receivers 11, 12, 13 and 14. Emissions from batch still receivers 1, 3, 4, 6, 7 and 8 are controlled by incinerating in #1 and 8 still burners. Emissions from the pelletizer are controlled by passing them through three cyclone scrubbers then through an electrostatic precipitator. Emissions from the continuous pitch unit are controlled by incinerating in the continuous unit furnace. Installation of these controls was started in 1972 and all necessary permits applied for as soon as state and city regulatory framework permitted.

GRANITE CITY

RCRA

The Granite City plant presently has interim status under Permit ILD06278360 to generate and store hazardous waste in piles and drums and also to operate a lagoon. Part B has been called in and is undergoing completeness and technical review by Region V and the Illinois EPA. Reilly also has a state experimental permit with a final operating permit pending.

WATER

Process waste water is treated in a wastewater treatment plant using an extended aeration bio-oxidation process. This process is covered by an experimental permit with final permit expected within the month. This treatment system consists of two collecting and primary/oil water separating tanks; two secondary A.P.I. type oil waste separators with surface skimmers; one equalizing tank; three 250,000 gallons bio-oxidation above ground tanks; and two clarifiers with associated aerators, pumps, piping and monitoring equipment. Waste water is first collected at various sources and pumped to tanks #99 and #100 where any creosote oil is allowed to settle and then returned to process. The waste water is then transferred through the A.P.I. type separators where residual traces of oil are removed and returned to process. The water is then pumped to the equalizing tank and then to the 250,000 gallon digesters for final treatment. This final treatment consists of bio-oxidation of the phenol. Based on pilot plant work it was determined a 13 day retention time was sufficient to remove the phenol to a level acceptable to the Granite City sanitary sewer department. Each of the three digester tanks is designed for a 6.8 day retention time which allows one tank to be available as a standby unit. Discharge from the digesters flows through a clarifier tank which discharges to a sampling pan containing an automatic continuous sampler. Final effluent is then to be discharged to the sanitary sewer system.

AIR

Reilly presently has eight permits covering all regulated emission sources. Emissions from still receivers are incinerated in the boilers and other emission sources on pitch storage tanks and loading facilities are controlled by air condensers and counter flow water scrubbers.

LONE STAR

RCRA

The Lone Star plant presently has interim status under Permit #TXD07328768 to generate and store material in drums. Part B has not been called in. A state RCRA Permit submitted September 2, 1983 has not been acted upon. We have a Texas Solid Waste Generator Number from the Texas Department of Solid Water Resources #30660.

WATER

All process waste water is treated by Lone Star Steel in their waste water treatment plant which is controlled under their NPDES Permit.

AIR

There are no existing emissions requiring a state permit.

PROVO

RCRA

The Provo plant presently has interim status under Permit #UTD009087644 to generate and store hazardous waste. Part B has been called in and has been approved for technical completeness. The public hearing for this permit was held on February 15, 1985.

WATER

The Provo plant has a NPDES Permit #UT0000370 granted October 1, 1973 for discharge of non-contact water. All process waste water is treated in a solar evaporation pan and is permitted under our RCRA permit.

AIR

The Provo plant has a USEPA air permit to operate our continuous distillation unit. This was granted by letter from Region VIII dated October 25, 1979. Emissions from pitch storage tanks are controlled by knockout tanks and air condensers. Approval of these controls by the state are covered in a letter dated January 2, 1974.

SUPPLEMENTAL RESPONSE TO INTERROGATORY NO. 10:

Reilly supplements its responses by referring plaintiff to the following claims involving health or environmental effects allegations which resulted in formal civil complaints:

Rowe, et al. v. Velsicol Chemical Corp. v. Reilly Tar & Chemical Corp., et al., Hamilton County (TN) Circuit Court Case No. 18850 (Settled Sept., 1979);

Everett Gluff v. Reilly Tar & Chemical Corp., Marion County (IN) Superior Court S582-0591 (Filed 5/7/82; Settled 8/84);

Dennis Griesemer v. Reilly Tar & Chemical Corp., Marion County (IN) Superior Court S782-0925 (Filed 7/21/82, Settled 8/84);

Velsicol Chemical Corp. v. Reilly Tar & Chemical Corp., U.S. District court (E.D. TN) 1-81-385 (Filed 9/24/81, Settled 8/20/84);

Altmeyer v. Reilly Tar & Chemical Corp., Marion County (IN) Superior Court S584-1407 (Filed 10/24/84).

SUPPLEMENTAL RESPONSE TO INTERROGATORIES NOS. 11-13:

Reilly supplements its prior responses with the following narrative discussion regarding pricing:

Coal tar pitch products which are primarily sold to the aluminum and graphite industries, consume by far the major share of crude coal tar for processing into electrode binders. The sale of these products has been, is now, and will continue to be a function of the reduction process of aluminum oxide to aluminum ingot and the production of metals in the electric furnaces.

Reilly does not produce coal tar. Crude tar is purchased under long term contracts negotiated with producers based on the fuel value relative to fuel oils as the base, plus incentives which induce the supplier to sell rather than utilize the crude tar as energy. Unit delivered cost has more than doubled since 1975. The oil glut has has little influence on tar prices since coking operations have been trimmed drastically because of EPA constraints. Despite the increasingly higher price of crude tar, Reilly must purchase the tar at posted prices in order to service its customers where foreign competition has not as yet taken over. The effect on the returns is significant since 350 gallons of crude tar, more or less, are required to produce one ton of binder pitch.

Foreign competition is and will remain severe since full employment as a social/political goal in producing nations must be maintained. It is well documented that Western Europe, Japan, Korea, Australia and others believe that northwestern U.S. pitch requirements are their battleground. In 1979-1980 Reilly lost approximately 30,000 tons due to foreign competition, including 18,000 tons as a direct result to the West Germans, and 6,000 tons to the Japanese. Reilly's participation ceased at one customer in 1980 after more than four decades of service. Reilly has not recovered any of the business in these markets.

As an example, between 1975 and 1980, Reilly's Provo refinery purchased an average of 10.4 MM gallons of crude tar annually. Its requirements since 1980 average about 5.3 MM. Reilly invested heavily at its Cleveland refinery to produce a specific customer's product and serviced their total requirements until West German competition reduced the price to such a level that Reilly could not compete. Other domestic suppliers have had similar experiences. Now foreign competition is considering remelting solid binder to supply users in the liquid form.

The production of aluminum is an energy intensive process. Between the Bonneville Power Administration power rates (the principal supplier of power to the aluminum industry), and EPA's cost constraints, foreign aluminum suppliers wait in the wings to pick their spots. Power rates in Canada are one-fourth to one-sixth that of domestic power rates. Aluminum ingot prices are at cost or lower. Imported metal is increasing at an alarming rate. Producers of crude tar cannot reduce their prices of tar since they must comply with EPA and compete with foreign coke producers. Foreign competition is here to stay; ingot prices and metal prices are a function of the world market. The higher cost aluminum plants will be closed. This is well documented, e.g., Lister Hill, Revere, Chalmette and Lake Charles aluminum plants. The new plants are being built in Canada where power is cheap and there are no EPA constraints on the producers. This opens the door for still further cutbacks in domestic production and makes it more inviting to foreign competition.

In short, the real price of pitch has fallen dramatically in the last two years as some U.S. pitch manufacturers have sought to buy back a share of the market from foreign competitors and/or maintain their share of a declining market by slashing prices. Reilly has had to meet this pricing competition.

The overall requirements for creosote oil in the wood treating industry has remained fairly constant since 1978.

In most cases, the pole and piling markets have decreased and the railroad crosstie has increased or remained the same. As time progresses, more and more importance is placed on the railroad crosstie market to consume the greater percentage of the creosote oil produced. Therefore, this product usually lives or dies in relation to the health of the railroads.

Purchasing procedures or practices have changed over the past years. The merging of several railroads has created centralized buying centers purchasing larger amounts and having more purchasing leverage. They are practically dictating prices that they will pay. Therefore, the competition is quite severe domestically as well as competition from Mexico and overseas. Also, the increased federal regulations on the wood treating industry have created demands for cheaper preservative to so that the individual companies can continue to operate while having to meet these very difficult regulatory demands.

The per unit return increased modestly, from 1978, peaking in 1981; thereafter, it declined in 1984 to approximately the 1980 level. Present pricing pressures indicate that these returns will remain depressed. The related distillates are presently being priced below energy levels to entice users to burn the product in place of fuel oil.

The requirements for coal tar enamel by the gas and oil industries have followed creosote oil and related products closely. The industry is depressed and will continue to be for the next several years. Pricing experienced modest increases, peaking in 1981; thereafter, it declined to pre-1981 pricing. This product group is faced with imports from Mexico and substitute products, usually at much lower prices.

Therefore, putting the depressed market into a competitive position with imports and substitutes leaves little hope for optimism for increased pricing.

<u>SUPPLEMENTAL RESPONSE TO INTERROGATORY NO. 19</u>:

Reilly supplements its prior response with the following information:

<u>OIL/WATER SEPARATORS (OTHER THAN ST. LOUIS PARK)</u>

(1) Cleveland (installed in 1959)

(a) 6'x8'x8' deep, rectangular shape hopper bottom, with no scrapers or oil baffle.

(b) Two double 3'x1'x5' straw filters.

(c) 12" thick reinforced concrete sides and bottom.

(2) Indianapolis

(A) North (installed in 1965)

(a) Two 30'-9"x10'x5'-3" deep sloping bottoms. 9" monolithlic sidewalls keyed to footings with 4" floor overpour of footing all reinforced. Constructed of concrete.

(b) No scraper but with oil baffle and skimmer.

(B) South (installed in 1948)

(a) 65'x19'x9'-8" bottom; no slope on bottom. 12" thick side walls and 1'-4" thick bottom. Constructed of concrete.

(b) Oil skimmer and flight cleaners (moveable baffles).

(c) Straw cleaner following unit.

(3) Chattanooga (installed in 1954)

(a) 10'x6'x5'-6" deep rectangular shape, hopper bottom; no scrapper or oil baffle.

(b) Two double straw filters.

(c) 12" thick reinforced concrete sides and bottom.

<u>SUPPLEMENTAL RESPONSE TO INTEROGATORY NO. 21</u>:

Reilly supplements its response by stating that a review of trade association files in its Indianapolis office revealed the presence of the attached documents. In addition, the RPAR response referred to in the prior response to Interrogatory No. 9 is responsive to this request. Reilly believes that plaintiffs have access to this document. Reilly also has in its possession the Annual Proceedings of the American Wood Preservers Association from approximately 1915 through the present. These annual published proceedings may contain published papers responsive to this request. Reilly can make these Annual Proceedings available to plaintiffs for their review; however, the publications are widely available in the public domain and may be more conveniently obtained by plaintiffs from a public library, such as the University of Minnesota's School of Forestry Library.

<u>SUPPLEMENTAL RESPONSE TO REQUESTS FOR PRODUCTION OF DOCUMENTS NOS. 2 and 3</u>:

Reilly supplements its response by referring plaintiff to the documents referenced in the Supplemental Response to Interrogatories Nos. 6, 7 and 8, <u>supra</u>. Doc. #303233-40 has previously been produced. Reilly believes plaintiff already has access to the federal and state permits and submissions referenced in the above response.

SUPPLEMENTAL RESPONSE TO REQUEST FOR PRODUCTION OF DOCUMENTS NO. 6:

Reilly supplements it prior response by stating that Reilly is aware that its former St. Louis Park plant site and current Indianapolis site are on the EPA's National Priorities List. Other than documents regarding the St. Louis Park former site, the only documents responsive to the request are Reilly's comments to the nomination of the Indianapolis site and the RI-FS work plan for the Indianapolis site authored by EPA and/or its contractor. Both documents are already in the possession of the EPA.

Dated: February 21, 1985

REILLY TAR & CHEMICAL
CORPORATION

By
Robert Polack

Subscribed and sworn to before me
this 21st day of February, 1985.

Marilyn Joyce Rawley
Notary Public
County of Morgan

Marilyn Joyce Rawley
Notary Public No. 102362
My commission expires
March 23, 1987

DORSEY & WHITNEY

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Attorneys for Defendant
Reilly Tar & Chemical
Corporation

Mr. P. C. Reilly   Indianapolis

R. J. Hennessy   March 23, 1971

WATER POLLUTION - U. S. Army Waste Materials Permit.

Last February 16 I called Mr. Ben Weakly of the Environmental Controls Division of the U. S. Army Corps of Engineers in Louisville, Kentucky and inquired about the availability of forms for registration under the refuse act.

Mr. Weakly informed me the forms were not then available but he expected something concrete within thirty days. He took my name and address and advised he would send the forms when they are available. To date I have not received them.

Following is a discussion of the waste disposal system now in use at all plants with a brief discussion of the existing problems and some suggested improvements. To date we have received no Federal requirements for the quality of industrial wastes.

Granite City

All liquid wastes are disposed into one of two evaporative and seepage ponds, both of which are located on our property. There is no drainage from either into streams or sewer systems. Since there is no effluent into a tributary of a navagable stream a U. S. Army Waste Materials Permit should not be required for Granite City.

Lima

All industrial wastes are now being discharged into the City of Lima sanitary sewer. Only surface water is running off into the Ottawa River.

The City of Lima requires our pH be 5.5 or higher. When it was checked in January it was 5.7.

Maywood

The City of Indianapolis has approved our plans for the construction of a sewer to discharge our waste water to the city sanitary sewer. Plans have been submitted to contractors and some proposals have been received which indicate the completed project will cost somewhat less than the preliminary estimate of $42,500 made in May of 1970. Contaminated surface water from an area of 7.29

acres will also be drained to the City sanitary system. The city knows about this and has given their approval.

Rain water draining from the remaining 72.7 acres will drain through the present Raymond Street sewer to Eagle Creek as at present.

Indianapolis Sanitary District sewer service charges will be based on the quantity of effluent with a surcharge for B.O.D. in excess of 350 mg/l and suspended solids in excess of 400 p.p.m. In December Maywood's flow was measured at 13½ g.p.m. with a B.O.D. of 434 mg./l. and suspended solids of 86 p.p.m. If this is typical it would result in a very low surcharge ($7.00 per month based on a total flow of 600,000 gallons to the sewer).

The pH must be controlled between 5.5 and 9.5. In the past the pH was measured from 8 to 10.9. In December it was 9.

Minnesota Street Plant

Industrial wastes from this plant are discharged into the City of Indianapolis sanitary sewer. The discharge is approximately 1,155,000 cubic feet per month which means the monthly usage charge based on the proposed schedule of sewerage service rates and charges would be $4600.

In addition to the above there is a surcharge for sewage with a B.O.D. strength index above 350 p.p.m. and a suspended solids index above 400 p.p.m. In December our B.O.D. was measured at 4373 p.p.m. and the suspended solids at 304 p.p.m. Based on a flow of 1,155,000 c.f.m. our monthly surcharge would be approximately $5,000 per month.

A sewer meter and a continuous sampler were ordered for the plant sewage system but are not yet installed. As soon as they are, accurate measurements of flows and representative samples may be obtained.

From the above it is obvious the two problems requiring immediate attention are: a. reduce the quantity of industrial waste by more efficient use of cooling water and by the installation of a condensate return system which should cut the water runoff by 250,000 cubic ft. per month at a saving of $1000 in usage charges alone.

b. Reduce the B.O.D. to a more acceptable level. Probably the most logical way to attack this problem is to eliminate as much of the polluants at the source rather than trying to treat the water after it is contaminated. Before any positive recommendations are made a study of the problem should be made.

Lone Star Plant

Waste water from this plant is collected in two evaporation ponds. The West basin collects discharge from steam coils, cooling water from still condensers, and the tank car loading area surface drainage. The East basin collects contaminated process water. The East basin never overflows, evaporation keeping the level of the water below the top of the dyke even in the winter. The West pond overflows occasionally, but this water is well settled and clean. The effluent flows through an open ditch to Lone Star Steel property and from there to Ellison Reservoir. Solid waste is disposed of in abandoned ore pits and earth covered on Lone Star Steel property.

Ironton

Waste water from the Ironton plant is discharged into Spring Creek which is a tributary to Utah Lake.

Water containing oil and some caustic soda or acid from the By Products building is drained to two waste ponds for settling. During the summer there is no effluent as evaporation enables the ponds to contain the discharge. During the winter water from subbing and precipitation causes the settled water to overflow and combine with accumulated field water and drain to Spring Creek.

A new road will probably be built through the area this summer eliminating the ponds. The plant proposes pumping the waste water into two holding tanks (nos. 30 and 31). From these tanks, after settling, the water will be dropped through a sand filter (a large metal pan containing graduated filter material, gravel on the bottom and sand on top) and then pumped to the field on our side of the road to evaporate or dilute. The water cut from the stills also will be handled by tanks 30 and 31 and the sand filter.

Boiler blowdown will go directly to the field.

Cooling water is pumped from Spring Creek, heated in the condenser coils, and returned to a cooling pond and returned to Spring Creek. This water is contaminated only when a leak occurs in a condenser coil. The plant proposes setting up a skimmer on the pond to separate any surface film. Outlet pipeswwill have turned down ells so discharge water is being pulled from under the surface.

Steam condensate is also discharged into the cooling pond.

Sanitary sewage from the Change Building, and the Laboratory and Office Building is disposed of by septic tanks and field drains.

St. Louis Park

The waste water from this plant is pumped through a primary oil separator and flows from there through a straw filter to the plant drain. Storm water falling into the area served by the drain enters and combines with the plant waste. The plant drain discharges into another straw filter and the water leaves the South end of the property into a ponding area between Walker Street and Highway No. 7, and then under Highway 7 to an area between Highway No. 7 and Lake Street. To the south of Lake there is an additional ponding area between Lake Street and the railroad tracks. The plant waste does not flow into Minnehaha Creek.

In addition to the above, water separated out of the tar in the tar cistern is allowed to flow over the ground to Walker Street. This contaminated waste then flows in the road ditch along Walker Street about five hundred (500) feet to the place where it merges with the remainder of the plant effluent just before running under Walker Street. It does not run through a straw filter or settling basin.

Plans for combining all plant waste, treating it in an oil water separator, discharging the water to the City sewer and reclaiming the oil have been drawn. The sanitary sewage would also be discharged to the City sanitary sewer.

The discharge of the city's storm water on to plant property from streets to the East and West pose a special problem at this location.

Chattanooga

All surface water and industrial wastes discharged into plant drains flow through the settling basin and straw filter to a 4'-0" sewer draining surface water from Velsicol Corporation. This sewer discharges into a 24" tile carrying the effluent to Chattanooga Creek which is tributary to the Tennessee River. Monthly reports have been made since 1948 to the State of Tennessee Stream Pollution Control Board on the quality of effluent discharged into the creek.

Water decanted from creosote oil, from tar in vats A, B, and C, and water of dehydration from the stills, is pumped to the decanting tank near the settling basin, let settle, then pumped to the old pitch cooler tank at the pitch bay, let settle again, then decanted to the pitch bay which has been converted into a bio-oxidation pond. This pond has an overflow to the sewer but it rarely has water over it because there is a 600 gallon per day leak through the dyke which keeps the level below the overflow.

All sanitary sewage is disposed of by septic tanks and field tile.

Fairmont

There are two separate ditches carrying all waste and surface water from this plant. Water from most of the plant is collected in a natural pond in the South central portion of the plant. From there it flows into a 6500 gallon settling tank. Since the flow varies from 4000 to 20,000 gallons per day depending on the weather, very good settling is obtained. The tar and oil layer is pumped back into the plant and the effluent flows through a ditch to the Monongahela River.

A second ditch at the North central portion of the plant collects boiler blowdown, steam condensate, and water from the Zeolite softener. Tar drips from road tar tanks 41 and 42 occasionally enter this ditch and the State has requested they be diverted to the effluent from the South end so the tar and oil will be settled out.

The ditch draining the North Central portion discharges into a ditch along the B. & O. tracks through which it flows to the Monongahela River.

Sanitary wastes from this plant are handled through a septic tank.

Mr. Neri advises the West Virginia Department of Natural Resources has been well satisfied with the work done by the plant to prevent pollution of the river.

Mobile

The effluent from this plant is discharged into a ditch running along a paved road owned by the Texaco Company. The water flows through a straw filter and then along the ditch to a sewer the outfall of which discharges into the Mobile River.

Mr. Cocke and Mr. Hagler advised they would take the four steps for the improvement of the quality of the runoff water at the Mobile plant as outlined in my letter dated March 12, 1971.

Cleveland Plant

Surface and waste water from this plant flow through two plant drains, one carrying contaminated water from the straw filter and settling basin to the City sanitary sewer, and the other discharging into Morgana Run.

Sources of contaminated water are:

1. Steam condensate and runoff from elevated tank farms.
2. Drainage of water from tar and oil tanks.
3. Drainage of water from decanting tank 19 and 47.
4. Underground tank pit sump pump.
5. A number of catch basins picking up area drainage.

In addition to the above the condenser water from all thirteen stills and steam condensate from tanks 124 to 127 are discharged into the sanitary sewer.

Connected to the uncontaminated sewer discharging into Morgana Run are the following:

1. Steam still and oil column condenser water.
2. Roof drains from the warehouse; still building; lab, shop, and pump room; and the change room.
3. Laboratory drains.
4. Naphthalene building drain.
5. A number of area drains.

At the present time the City of Cleveland is insisting we lower the temperature of our effluent to 110° F or below. They have checked the temperature of our sewage as high as 161° F and it averages 134° F. The most practical way to accomplish this is to circulate the condenser water from the thirteen still condenser pans over a cooling tower and reuse it. This water is heated to 170° in the pans. Since the wet bulb temperature on the hottest days in Cleveland is 75°, the water could be cooled to 85° F in the cooling tower. The savings in water and sewer charges would be approximately $10,000 per year.

There is a drain in the bottom of the underground tank pit which connects to the uncontaminated sewer. Surface water flows into this tank pit from two pipe trenches, one from the tank car loading racks to the South, and the other from the pipe trench crossing the plant road and connecting the warehouse with the pit. When more water flows in than the sump pump can pump to the contaminated sewer, it rises in the pit and flows out the drain to the uncontaminated sewer. This drain should be sealed and a standby pump installed.

Spillage in the area of the 55 to 57 tanks Southeast of the warehouse drains to an adjacent catch basin in the uncontaminated sewer. Any spillage in this area should be caught and pumped to the 47 ground tank for settling.

Rain water at the Cleveland plant is a serious problem. Tank farm no. 1 currently drains through a hole in the East dyke onton a curve on the 800 track. The water flows north alongside the railroad tracks and roadway making the roadway mushy and difficult to maintain. The area between the pole barn and the elevated pan is used as a turning area and roadway for trucks moving pellet pitch and this is a sea of muck when wet. The plant plans to construct a fire seal through the North dyke of tank farm 1 and drain this area to the pipe trench of tank farm no. 2 which is in turn drained by a connection to the contaminated sewer. They will then seal the drain through the East dyke.

Sanitary sewage from the Office and Change Room enter our contaminated sewer downstream of the straw filter and is discharged into the Cleveland sanitary sewer.

We have not had a permit for discharging industrial wastes into Morgana Run since our connection to the Cleveland sanitary sewer.

Norfolk Plant

The only visable flow from the plant to the Elizabeth River is the effluent from a covered drainage ditch discharging into the river at the Southwest corner of the plant. An open drainage ditch from the East end of the South side of the plant conveys rain water to the closed ditch mentioned above. Also discharging into it are the blowdown from boilers, the water to wash the zeolite softeners, the discharge from the septic tank at the Laboratory and Washroom, and a settling pan South of #4 tank. Pipe trenches in front of the treating and working tanks convey oil drips and leaks from pipe lines and rainwater to this settling pan. Oil from the bottom is pumped into the dehydrating tanks. This pan overflows during a heavy rain causing the discharge of oily water to the river.

The majority of the water is used in the barometric condenser and this contaminated black water is discharged into an artificial pond sealed off from the stream by shavings. The water trickles through the shavings into the river.

The drippings from the cylinder room, and the condensate from steaming operations in the cylinders all go to a sump in the center of the treating room where it is pumped into #4 settling tank. Water settled in this tank flows through a 2" line to a settling pit in the middle of the big pile of shavings. The overflow trickles through the shavings to the river.

Shavings disposal is becoming a problem. A culvert under the railroad track along the East property line drains the area East of our plant to the river. The plant proposes cutting a drainage ditch from this culvert running North along the railroad track to the North property line; thence West to the river. This will allow the plant to gain enough area to continue to blow shavings for one year. Thereafter they will have to be disposed of in some other manner, as by burning under a boiler or in an incinerator. This will require a permit from the local air pollution authorities.

The Norfolk sanitary district seems reluctant to permit wastes from a wood treating plant to enter their sanitary sewer. I sent John Shuler copies of letters showing Indianapolis and Lima will accept our effluent in the hope this may sway them.

If we cannot enter the city sewer we can either install a cooling tower to circulate the barometric condenser water as we did at Haywood or we can replace the barometric condenser with a surface condenser.

Very truly yours,

R. J. Hennessy

RJH:db

U.S. Department of Labor

Occupational Safety and Health Administration
Washington, D.C. 20210

Reply to the Attention of:

MAR 2 1981

Mr. Lucian M. Ferguson
Executive Vice President
American Coke and Coal
Chemicals Institute
300 North Lee Street
Suite 306
Alexandria, Virginia 22314

Re: Coal Tar (Comment No. 5-33-3), and Creosote (Comment No. 5-34-4) 1980 Candidate List, Docket No. H-090A

Dear Mr. Ferguson:

We have received and reviewed your comments concerning the inclusion of coal tar (CAS No. 8007-45-2) and creosote (CAS No. 8001-58-9) on OSHA's Candidate and Priority Lists.

Based on currently available experimental carcinogenicity data, OSHA believes that coal tar and creosote should remain candidates for further review. We have reviewed the reports of industrial health studies at tar distillation plants that you included with your comments. Based upon scientific review, these studies do not constitute confirmation that coal tar is <u>not</u> an occupational carcinogen. The two worker exposure surveys measured worker exposures during 1978 and 1980. Although they examined worker exposures, they were not designed to examine health effects among workers; in particular, they did not attempt to determine the incidence of cancer among these workers.

We feel, however, that further information is necessary in order to arrive at an appropriate determination of the priority to be given to these substances. As indicated in OSHA's Cancer Policy, priority assignments will not be based on health hazard alone, but will be based also on consideration of population at risk, current employee exposure, existing means of exposure control, nature of the operation, etc. OSHA will not pursue regulatory activity where these other factors demonstrate that it is neither necessary nor appropriate to do so. Your comments regarding current industrial conditions in coal tar distillation plants will be given consideration towards that determination.

Your interest in OSHA's programs and policies is appreciated.

Sincerely,

Bailus Walker

Bailus Walker, Jr., Ph.D., M.P.H.
Director
Health Standards Programs

cc: Dr. Peter Infante
Docket Office

418560

June 15, 1982

BEFORE THE
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
UNITED STATES DEPARTMENT OF LABOR

Hazard Communication/ Docket No. H-022

Comments of
the American Coke and Coal Chemicals Institute
on Notice of Proposed Rulemaking

These comments are submitted by the American Coke and Coal Chemicals Institute in response to the notice of proposed rulemaking, Hazard Communication, Federal Register of March 19, 1982, at page 12092.

The American Coke and Coal Chemicals Institute is a nonprofit trade association with principal office in Alexandria, Virginia which represents the merchant coke producers, the tar distillers of the United States, as well as chemical producers and processors. Comments are made on behalf of the members of the Institute.

The American Coke and Coal Chemicals Institute endorses the comments on the proposed rulemaking by the American Iron and Steel Institute and by United States Steel Corporation, particularly those comments relating to the necessity for a unified Federal Hazard Communication Standard which is pre-emptive over state, county and municipal worker right-to-know regulations. We also support OSHA's effort to develop a hazard communication standard which is performance oriented and which can be implemented in the wide variety of producer and processor plants represented in our membership.

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The American Coke and Coal Chemicals Institute also endorses the comments of the Chemical Manufacturers Association on the proposed rulemaking and offers comments on the proposed 29 CFR section 1910.1200 as follows:

(a)(3) - Mixtures should be defined as intentionally blended mixtures, and should not include naturally occurring mixtures, such as creosote.

(b) Definition of "container" - Reaction vessels and storage tanks should be excluded from the definition.

(b) Definition of "Employer" - Importers of chemicals should be specifically included in the definition.

(c)(1) and (2) Hazard Communication Program - The term "work area" should be substituted for "workplace" as appropriate. Seldom does a worker's job performance require that he work in all areas of the workplace, or even in more than one. Exceptions are maintenance workers, messengers, etc.

(e)(3) Material safety data sheets - The standard should provide that there be no blank spaces on the MSDS, and that the appropriate comment should be "information found, but not considered valid".

(e)(4) and (5) Material safety data sheets - the provisions of these subsections are not clear. The time frame for sending out updated MSDS's needs clarification.

The modifications proposed in this statement, and in the statements we endorse, will result in an improved standard which will contribute to improved safety and health in American workplaces.

Respectfully submitted,

Lucian M. Ferguson
Executive Vice President

American Coke and Coal Chemicals Institute
300 North Lee Street, Suite 206
Alexandria, Virginia 22314

LMF:jbc

AMERICAN COKE AND COAL CHEMICALS INSTITUTE
300 NORTH LEE STREET, SUITE 306 ALEXANDRIA, VIRGINIA 22314

August 26, 1982

BEFORE THE
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
United States Department of Labor

Notice of intention to) modify interpretation) of coal tar pitch) volatiles)	Docket No. H-365

Comments of
the American Coke and Coal Chemicals Institute
on Notice of Intention to Modify Interpretation

The American Coke and Coal Chemicals Institute is a nonprofit trade association with principal office in Alexandria, Virginia. The Institute represents the merchant coke producers, the tar distillers of the United States, as well as chemical producers and processors. Comments are made on behalf of the members of the Institute.

By notice in Federal Register Volume 47, number 104 at page 23482 OSHA announced its intention to modify its interpretation of coal tar pitch volatiles (CTPV) contained in 29 CFR 1910.1002. OSHA summarized that the proposed rule would make it clear that the CTPV standard does not cover petroleum asphalt or other substances that are not derived from coal. To achieve this end OSHA intends to delete reference to "Petroleum, wood, and other organic matter" from the present definition, leaving the interpretation to include polycyclic hydrocarbons which volatilize from the distillation residues of coal only.

418563

Promulgation of the proposed rule will leave petroleum pitch, a substance substantially similar in chemical composition to coal tar pitch, outside the definition of CTPV and the eight-hour TWA exposure limit of 0.2 mg/m^3. We cannot believe that OSHA intends to exclude the higher melting point asphalts and petroleum pitches from the present standard which affords employee protection from the harmful effects of the proven carcinogens contained in those substances.

Much of the present confusion and lack of specificity in the coverage of the CTPV standard stems from the term "coal tar pitch volatiles" used in 29 CFR 1910.1000, Table Z-1. We recommend that OSHA institute full proceedings under section 6(b) of the Occupational Safety and Health Act in the near future to change the term "coal tar pitch volatiles" to a more descriptive term such as "fused polycyclic hydrocarbons" or "polycyclic aromatic hydrocarbons" and to include asphalt at an appropriate TLV. Care should be exercised to include asphalt at a lower TLV when high application temperatures are employed which may convert the material to a more aromatic mixture.

Under Supplementary Information at page 23482 of Federal Register Volume 47, number 104, the distinction is drawn between "...distillations that are destructive, such as occur from coal or wood distillation, and not the common petroleum distillations that are non-destructive." Whether the distillation is destructive or not is not pertinent. When determining an appropriate worker exposure limit the principal factor should be the composition of the pitch volatiles, regardless of the source of the pitch. If pitches were produced by evaporating the volatile light ends of coal tar and petroleum, pitches of very different chemical composition would be produced. Coal tar pitches and any CTPV released from them would be highly aromatic, as is coal tar. Petroleum pitches, and the pitch volatiles released would be highly aliphatic. Electrode binder pitches which are used in the carbon and graphite industries are a very important series of commercial products. Highly aromatic pitches are functionally the most suitable materials for binding the petroleum coke which, after carbonization and graphitization, become the electrode for use in steel and aluminum and other industries. Historically, the pitches have been produced from coal tar, which is highly aromatic. Pitches produced from petroleum by distillation only are not suitable. So petroleum pitch producers utilize soaking furnaces, oxidizers, or both, to produce pitches closely resembling coal tar pitch. Both contain essentially the same chemical compounds, and in substantial amounts. A comparison of the chemical composition of the benzene-soluble fractions of the coal tar-derived and petroleum-derived pitches is attached.

The recent Arthur D. Little, Inc. toxicological report Roofing Asphalts, Pitch, and UVL Carcinogenesis (NIOSH Contract number 210-78-0035) indicates that exposure to petroleum pitch and asphalt fumes represent a significant carcinogenic risk. While the report indicates that elimination of some petroleum derived asphalts from the CTPV definition may be warranted, it also indicates that other petroleum-derived products, such as petroleum pitch, should not be excluded from the 0.2 mg/m^3 exposure limit.

Under the proposed interpretation of the definition of coal tar pitch volatiles petroleum pitches, which are chemically very similar to coal tar pitches, would be excluded solely because they are not derived from coal. If the end result is that worker exposure is permitted to be twenty-five times higher (5mg/m^3 vs. 0.2 mg/m^3) when petroleum pitches are used, coal tar pitch producers will be at a substantial, and unwarranted, commercial disadvantage. The tar distillers have operated their plants for over ten years under the CTPV 0.2 mg/m^3 standard and have done so in substantial compliance with this strict standard, as have the petroleum asphalt and petroleum pitch industries. Changing the interpretation of the definition of CTPV could result in serious economic damage to the tar distillers. The "Summary of Regulatory Impact Assessment" contained in the proposed rule (Federal Register, Vol. 47, No. 104, pages 23483 and 23484) deals with asphalt and coal tar roofing applications and shows a basic misunderstanding of the economic issues involved. The most important economic issue is pitch, and the possible disastrous effect that the proposed interpretation could have on the tar distillers' sales to the electrode industry. A conversion to petroleum pitch by the aluminum and steel industries, although the coal tar pitch is far superior for the purpose, would have far-reaching economic consequences for the tar distillers.

We have alternative recommendations as to the proper action to be taken by OSHA on this proposal to modify its interpretation of coal tar pitch volatiles contained in 29 CFR 1910.1002.

1. OSHA should take no action to modify at this time, but should institute rulemaking under section 6(b) of the Occupational Safety and Health Act in the near future to amend 29 CFR 1910:1000(Table Z-1) to include a new, reasonable standard for asphalt, and to change the term "coal tar pitch volatiles" to a more descriptive and inclusive term such as "fused polycyclic hydrocarbons" or "polycyclic aromatic hydrocarbons".

2. As pointed out above, coal tar pitches and petroleum pitches used in industry contain essentially the same chemical compounds and should be treated the same in the regulatory process. Comparative analysis of high melting point petroleum pitches and coal tar pitches indicate that both have significant (greater than 0.1%) levels of benzo(a)pyrene and measurable levels of chrysene, phrene, phenanthrene, anthracene, and acridene. Although coal tar pitches generally contain higher levels of benzo(a)phrene than petroleum pitch, this difference does not negate hazards which are substantially equivalent.

Although there are many identifiable carcinogens in distillates of organic matter, OSHA should designate benzo(a) pyrene as an indicator of carcinogenic potency for organic materials and adopt the following interpretation of the term coal tar pitch volatiles:

"As used in §1910.1000(Table Z-1) coal tar pitch volatiles include the fused polycyclic hydrocarbons which volatize from the distillation residue of organic matter containing benzo(a) pyrene at levels of 0.1% or greater."

Respectfully submitted:

Lucian M. Ferguson
Executive Vice President

LMF:jbc

Chemical Composition of Benzene-Soluble Fractions of Coal Tar-Derived and Petroleum-Derived Pitches

Compound, ppm	Coal Tar Derived Pitch	Petroleum Derived Pitch
Naphthalene	1.4	0.9
Methylnaphthalene	ND	0.9
Acenaphthene	7.1	1.1
Phenanthrene + Anthracene	29.7	12.5
Carbazole	2.5	2.0
Fluoranthene	33.2	15.8
Pyrene	35.2	39.6
Chrysofluorene	5.2	ND
Chrysene Benzanthracene	49.9	29.6
Benzanthrone	7.2	12.0
Benzofluoranthene	49.5	21.8
Benz (a) pyrene	32.0	3.4
Benz (e) pyrene	90.0	3.4
Perylene	24.7	13.9
Dibenzanthracene	42.1	ND
Anthanthrene	21.9	ND
Unidentified	956,800	984,000
Benzene Soluble, wt % of Pitch	73.3	70.8

Attachment to submission by American Coke and Coal Chemicals Institute

418567

R/P

CMA p.u

THE CMA HAZARDOUS WASTE SURVEY FOR 1981 AND 1982

FINAL REPORT

CMA

CHEMICAL MANUFACTURERS ASSOCIATION

Formerly Manufacturing Chemists Association — Serving the Chemical Industry Since 1872.

418568

THE CMA HAZARDOUS WASTE SURVEY FOR 1981 AND 1982

FINAL REPORT

418569

CHEMICAL MANUFACTURERS ASSOCIATION

EXECUTIVE SUMMARY

INTRODUCTION

Earlier this year, the Chemical Manufacturers Association commissioned an independent study of its member companies' waste management practices. One of the objectives of the survey, which was conducted by Environmental Resources Management Inc., of West Chester, Pa., was to define these practices more accurately so that the continuing public debate over waste issues could proceed with a greater degree of precision.

Seventy member companies responded to the survey. Information was provided on 535 plants.

In addition to being asked to identify their various waste management techniques, respondents also were asked for an accounting of the total volume of waste generated, treated and disposed of at their plants in 1981 and 1982.

Wastes defined by either state or federal regulations as hazardous were included in the survey. Respondents also were asked to include wastewater -- as well as non-aqueous (or solid) -- wastes in their totals.

Although the survey is not a 100 percent sample of the chemical industry, it is believed the survey identified nearly all of the hazardous waste generated by the industry as a whole. This conclusion is based on two key factors:

In an earlier survey (August 1981) of more than 14,000 hazardous waste generators in all industries, the Environmental Protection Agency concluded that 1-2 percent of the generators accounted for 90 percent of the waste. Information for the CMA survey was gathered by ERM from nine of the 10 largest U.S. chemical producers and 33 of the 50 largest producers (ranked by sales volume).

In addition, a comparison of the CMA and EPA surveys indicates that CMA's sample agrees closely with the preliminary projections made by the Agency of the volume of hazardous waste disposed of by the chemical industry.

Formerly Manufacturing Chemists Association—Serving the Chemical Industry Since 1872.
2501 M Street, NW • Washington, DC 20037 • Telephone 202/887-1100 • Telex 89617 (CMA WSH)

Waste volumes in the CMA survey are subject to increase, of course, because the survey represents less than 100 percent of the industry. Any increases would be small.

Major Survey Findings

The ERM survey presents, for the first time, a clear picture of chemical industry waste management practices — and trends. Nowhere, perhaps, is this more evident than in the survey's findings on what the industry does with the wastes it generates.

The survey found that 99 percent of the waste generated by the industry is wastewater (See Table 1) — which is classified as hazardous under the EPA's "mixture rule." This federal regulation holds that if any waste defined as hazardous under the Resource Conservation and Recovery Act is added to the flow to a wastewater treatment facility, then the entire volume of the stream is considered hazardous.

The result of the "mixture rule" is an enormous amount of highly diluted waste. The survey found that 97 percent of this waste is treated by the industry and rendered non-hazardous in wastewater treatment plants (See Table 2).

Most of this treatment occurs in on-site facilities permitted under the federal Water Pollution Control Act NPDES program. A much smaller amount is treated in publicly owned treatment facilities (POTWs).

The total volume of disposal by all methods fell by eight percent in 1982 on a "wet ton" basis (and was down by 42 percent on a "dry ton" basis) from the year before, the survey found.

For example, the survey found that the industry's use of landfills as a disposal method was cut by more than one-half (51 percent on a "wet ton" basis and 59 percent on a "dry ton" basis) between 1981 and 1982 (See Table 3).

Although much of this reduction can be attributed to sluggish business conditions, some of the reduction is the result of industry efforts to reduce the volume of waste generated or increase the volume of waste it treats.

At the same time, treatment of hazardous waste (excluding wastewater) increased by nearly 60 percent during the two-year period. The treatment methods used included chemical, thermal, and biological technologies — as well as incineration. As for the latter method, the survey found the industry has 150 incineration units (one-half of the total U.S. incineration capacity). More than a half-million tons of waste are incinerated annually, the survey found.

In addition, the survey found the industry also recycles, reuses or reclaims about a half-ton of hazardous waste for every ton it discards.

The earlier data collected by EPA shows the chemical industry accounts for 71 percent of the hazardous waste generated each year in the U.S.

However, it accounts for a substantially lower percentage of the waste actually disposed of each year. Based on the EPA and CMA data, the industry disposes of a little more than one-third (36 percent) of the hazardous waste generated by all industries annually.

Of the 21 million tons disposed of by the industry in 1982 (23 million tons in 1981), the majority (70 percent) was wastewater (See Table 3). This wastewater, the survey found, is disposed of by deepwell injection into unusable geological formations 1,000 to 10,000 feet below the surface. These are typically difficult-to-treat and diluted wastes which, if treated in conventional methods, would harm surface water quality. (Deepwell injection is a federally permitted disposal method and is controlled under the 1975 Safe Drinking Water Act's underground injection control program).

Landfills, the survey found, are the next most widely used disposal method (See Table 3).

CMA HAZARDOUS WASTE SURVEY
1981 - 1982 SUMMARY DATA

	UNITS - THOUSAND TONS			
		1981		1982
NERATION:				
WASTEWATER		716375		701218
SOLID WASTE				
FEDERAL	3964		2699	
STATE	3096		2271	
TOTAL		7060		4970
TOTAL GENERATION		723435		706188
REATMENT:				
WASTEWATER				
ON-SITE				
NPDES	596708		585033	
MUNICIPAL				
POTW	39638		40533	
OTHER				
TREATMENT(a)	61428		57348	
TOTAL		697774		682914
SOLID WASTE				
INCINERATION	595		458	
OTHER TREATMENT	1443		2794	
TOTAL		2038		3252
TOTAL TREATMENT		699812		690072
DISPOSAL:				
WASTEWATER				
INJECTION		16338		16116
SOLID WASTE				
LANDFILL	1540		792	
IMPOUNDMENT (b)	511		474	
LAND				
APPLIC'N	26		1	
OCEAN				
DISPOSAL	36		24	
WASTE PILES (c)	696		405	
INJECTION				
WELLS (d)	4028		3574	
TOTAL		6837		5270
TOTAL DISPOSAL		23175		21386

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EXPLANATORY NOTES

DATA SUMMARY TABLES

.. See ERM Report, Pg 4-28. These values cover wastewater neutralized and rendered non-hazardous.

ı. See Addenda note 4. Use Table 14A for these values.

:. Shown as 'other' in ERM report, Tables 14 & 15. See Addenda notes 1 & 3.

1. Corrected for double-entry, see Addenda note 2.

418574

THE CMA HAZARDOUS WASTE SURVEY FOR 1981 AND 1982

FINAL REPORT

September 1983

Submitted To:

Chemical Manufacturers Association
2501 M Street, N.W.
Washington, D.C. 20037

By:

Environmental Resources Management, Inc.
999 West Chester Pike
P. O. Box 357
West Chester, Pennsylvania 19380

Environmental Resources Management, Inc.

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SECTION 1

INTRODUCTION

The primary objective of the project was to establish a hazardous waste data base to:

- encompass the chemical industry, e.g., survey all 1,200 plants of the 163 CMA member companies,
- quantify hazardous waste generation and disposal for 1981 and 1982,
- provide reasonably accurate, comparable, reproducible, and verifiable numbers,
- establish the routes by which hazardous waste is disposed of,
- utilize existing data, minimize completion time, and be as simple as possible,
- protect confidentiality, and
- be flexible...allowing future updates and microstudies of particular interest.

SECTION 2

STUDY APPROACH

To meet the project objectives, a self-administering questionnaire was developed. In order for the survey to be completed accurately and in a reasonable time, several factors were addressed.

- The survey form itself was kept simple to avoid intimidating the respondents.
- The survey form was designed to return the maximum amount of useful information. Instructions were concise and clear.
- The survey sought available information. Only information that had been previously reported to EPA and/or state regulatory agencies was requested to minimize the amount of time necessary for retrieval.
- The format was intended to permit easy transcription of the data to computer tape for data management.
- Only plants designated as 2800-SIC Code facilities (chemical manufacturing) were asked to participate.

Following the development of the questionnaire, a pilot survey was administered to ten plants representing a wide range in production size. The pilot survey response was evaluated for required completion time, clarity, and utility of the data. After discussion of the pilot survey results, a final questionnaire was developed and then distributed by CMA to its member companies for circulation to their plants.

It was recognized that chemical companies which were not members of the association could not be petitioned and, of those that were petitioned, not all would necessarily respond. Therefore, while every effort was made to be complete, not all chemical plants were represented in the survey. Thus, a method of extrapolating the survey data to industry-wide totals was considered. The parameter used to "scale-up" or extrapolate the respondents' data to industry-wide totals was value-of-shipment. This information was provided by the company coordinators for all plants which participated in the survey.

After the completed questionnaires were received by ERM from the plants, they were coded and placed into a custody protocol system. ERM reviewed each questionnaire for reasonableness and consistency. Where more complete answers or clarification of questions was desirable, ERM telephoned the plant for clarification.

To assure confidentiality, all questionnaires received a unique code number. When the questionnaires were returned, the cover sheets containing all of the individual facility's identification information (e.g., company name, code name, address, contact person, title, contact telephone number) was detached. The original cover sheets were filed and arranged by code number in a locked, fireproof cabinet. Neither copies nor a backup file of the cover sheets were made. Upon completion of the project and following authorization from CMA, the cover sheet file will be destroyed (shredded) to preserve permanent confidentiality.

SECTION 3

DATA MANAGEMENT

The completed questionnaires were double keypunched (keypunched and verified) on computer tape to assure accuracy. The data were then analyzed on an IBM 370 main-frame computer system using SAS (Statistical Analysis System). Data analysis consisted of three phases: (1) descriptive statistics of all variables, (2) trend analyses to examine potential changes between 1981 and 1982 practices, and (3) extrapolation of the data to estimate industry-wide totals.

Descriptive statistics for all waste categories were calculated to summarize the respondents' waste quantities. These parameters included: the mean, standard deviation (S.D.), sum total, variance, standard error of the mean, and the coefficient of variation (C.V.). These statistics were used to make qualitative comparisons between different variables or between years for the same variable. The descriptive statistics are included in Appendix A.

Trend analyses were limited because only 1981 and 1982 data were gathered. However, two analytical approaches were used for interpreting short-term patterns in hazardous waste generation by CMA member facilities. First, the relationship between certain interrelated hazardous waste categories was established for both years. Then, the two years compared to determine if any significant change had occurred in this relationship between 1981 and 1982. Second, we compared statistically the mean quantities of various waste types between years.

Regression analysis was utilized to accomplish the first trend analysis objective. Relationships were examined to determine if the relationship was statistically significant ($H_0 : \beta = 0$, $P < 0.05$) and how much variation was explained by the regression. The relationship was compared for 1981 and 1982 to determine if a significant change ($\beta_1 = \beta_2$, $P < 0.05$) had occurred in this relationship between years. This comparison was made by testing the slopes (β) of the two regression lines to determine if they are significantly ($P < 0.05$) different. This type of analysis was used to identify the potential effects of industry-wide changes between 1981 and 1982.

The second type of trend analysis conducted was a series of statistical tests comparing the mean 1981 and 1982 quantities of each waste generated. These comparisons were conducted for several of the more important waste categories. The statistical technique best suited for this series of analyses was the Student's t-test for paired observations. The paired observations were the 1981 and 1982 waste quantities for each facility. The number of observations making up the mean quantities for a given waste category was equal to the number of plants which provided waste data for both years.

Extrapolation of industry-wide totals for certain variables was conducted by two methods: (1) a simple proportional relationship and (2) regression analysis. Both methods employed the value-of-shipment data as the "scale-up" factor. The regression method was the preferred approach as it provides an estimate of statistical confidence about the projected value. However, the relationship between the value-of-shipment (independent variable) and the dependent variable (e.g., total waste generation) was found to be weak in most cases. Therefore, the proportional method was used to compare the results of an alternative method of extrapolation.

SECTION 4

RESULTS

Summary of Survey Response

Seventy of CMA's 163 member companies, or 43 percent, participated in the survey (Table 1). Of the approximately 1,200 plants which these companies represent, approximately 45 percent (536) provided 1981 data and 44 percent (528) provided data for calendar year 1982 (Table 1). The responding companies include 33 of the top 50 companies in chemical sales.[1] In terms of value-of-shipment, the survey response accounted for 38 and 33 percent of the 1981 ($175.1 billion) and 1982 ($172.4 billion) Department of Commerce figures for total value-of-shipment for the entire chemical manufacturing industry (2800-SIC Code plants), respectively.

The fact that the sample represents 66 percent of the top 50 companies indicates that the larger plants/companies may be overly represented in the sample. This would suggest that an inherent sample bias exists if the waste generation and disposal practices of larger facilities are different from smaller ones. Therefore, to the extent that this difference is not known, caution should be used when extrapolating the results of this survey to the entire CMA membership and the chemical industry as a whole.

The geographical distribution of the responding plants by state is given in Table 2 for both years. Seven states (i.e., Texas, New Jersey, Louisiana, California, Ohio, Illinois, Michigan) accounted for over half (approximately 54 percent)

1 Chemical and Engineering News, June 13, 1983, p. 36.

TABLE 1

SUMMARY OF RESPONDENT SAMPLE SIZE

	1981	1982
Companies	70	70
Plants	536	528
Value-of-Shipments (Dollars)		
Total	67.07 billion	57.65 billion
Mean	1.14 billion	0.99 billion

TABLE 2

GEOGRAPHICAL DISTRIBUTION OF RESPONDENTS
BY STATE

State	1981 Number Responding	1981 Percent	1982 Number Responding	1982 Percent
AL	18	3.4	18	3.4
AZ	1	0.2	1	0.2
AR	3	0.6	3	0.6
CA	37	6.9	36	6.8
CO	1	0.2	1	0.2
CT	3	0.6	3	0.6
DE	8	1.5	8	1.5
FL	6	1.1	6	1.1
GA	11	2.1	11	2.1
ID	1	0.2	1	0.2
IL	28	5.2	26	4.9
IN	10	1.9	10	1.9
IA	7	1.3	7	1.3
KS	4	0.7	4	0.8
KY	11	2.1	11	2.1
LA	38	7.1	36	6.8
MD	5	0.9	5	0.9
MA	6	1.1	5	0.9
MI	20	3.7	21	4.0
MS	6	1.1	6	1.1
MO	12	2.2	12	2.3
MT	1	0.2	1	0.2
NE	2	0.4	2	0.4
NV	1	0.2	1	0.2
NH	1	0.2	1	0.2

TABLE 2 (continued)

State	1981 Number Responding	1981 Percent	1982 Number Responding	1982 Percent
NJ	50	9.3	49	9.3
NY	19	3.5	20	3.8
NC	14	2.6	14	2.7
OH	31	5.8	30	5.7
OK	3	0.6	3	0.7
OR	5	0.9	5	0.9
PA	16	2.0	16	3.0
SC	11	2.1	10	1.9
TN	15	2.8	15	2.8
TX	83	15.5	83	15.7
VA	12	2.2	13	2.5
WA	5	0.9	5	0.9
WV	17	3.2	17	3.2
WI	4	0.7	3	0.6
WY	3	0.6	3	0.6
PR	6	1.1	6	1.1
Total	535	100	528	100

of the plants in both years. A total of 40 states and one United States territory (Puerto Rico) were represented (Table 2).

Plant Characteristics of Respondents

Table 3 indicates the frequency of response for all of the 2800-SIC Codes reported. A total of 27 different product categories were represented. However, the majority of the respondents fell into three major categories: miscellaneous industrial inorganic chemicals, plastic materials and synthetic resins, and miscellaneous industrial organic chemicals.

Table 4 illustrates the frequency of response for all of the non-2800 SIC Codes reported. A total of nine manufacturing product categories were reported and five non-manufacturing categories. The three most frequently reported non-2800 categories were: food and kindred products, rubber and miscellaneous plastic products, and transportation, communication and utilities. The fact that the non-2800 SIC Codes were seldom applicable to a responding facility indicates that only 2800 facilities, as designated by the Department of Commerce, responded to the survey as intended.

Table 5 illustrates the general type of plant which responded to the survey. Most facilities (approximately 65 percent) were manufacturing plants only. Thirty percent of the respondents were a combination of manufacturing and research, and only two percent were entirely research facilities.

TABLE 3

SUMMARY OF 2800 - SIC CODES
REPRESENTED BY RESPONDENTS

SIC Code	Product Type	Responses Number (Percentage) 1981	1982
2812	Alkalies and Chlorine	47 (9)[1]	47 (9)
2813	Industrial Gases	10 (2)	10 (2)
2816	Inorganic Pigments	19 (4)	19 (4)
2819	Miscellaneous Industrial Inorganic Chemicals	141 (26)	140 (26)
2821	Plastic Materials, Synthetic Resins	157 (29)	154 (29)
2822	Synthetic Rubber	29 (5)	28 (5)
2823	Cellulosic Man-Made Fibers	1 (<1)	1 (<1)
2824	Synthetic Organic Fibers	23 (4)	22 (4)
2831	Biological Products	3 (1)	3 (1)
2833	Medicinal Chemicals, Botanical Products	10 (2)	10 (2)
2834	Pharmaceutical Preparations	19 (4)	18 (4)
2841	Soap and Other Detergents	30 (6)	27 (5)
2842	Specialty Cleaning, Polishing	2 (<1)	3 (1)
2843	Surface Active and Finishing Agents	25 (4)	26 (4)
2844	Perfumes, Cosmetics, Toilet Preparations	4 (1)	4 (1)
2851	Paints, Varnishes, Lacquers	16 (3)	15 (3)
2861	Gum and Wood Chemicals	12 (2)	12 (2)
2865	Cyclic Crudes and Intermediates	50 (9)	48 (9)
2869	Miscellaneous Industrial Organic Chemicals	218 (41)	213 (41)
2873	Nitrogenous Fertilizers	21 (4)	21 (4)
2874	Phosphatic Fertilizers	6 (1)	5 (1)

TABLE 3 (continued)

SIC Code	Product Type	Responses Number (Percentage) 1981	1982
2875	Fertilizers, Mixing Only	0 (<1)	0 (<1)
2879	Miscellaneous Pesticides and Agricultural Chemicals	65 (12)	62 (12)
2891	Adhesives and Sealants	13 (2)	13 (2)
2892	Explosives	11 (2)	11 (2)
2893	Printing Ink	2 (<1)	2 (<1)
2895	Carbon Black	10 (2)	9 (2)
2899	Miscellaneous Chemicals and Chemical Preparations	47 (9)	47 (9)

[1] Numbers in parentheses represent rounded percentages using the number of responding plants as the divisor.

TABLE 4

SUMMARY OF NON-2800 SIC CODES
REPRESENTED BY RESPONDENTS

SIC Code	Manufacturing Product Type	Responses Number (Percentage) 1981	1982
2000-2099	Food and Kindred Products	15 (3)[1]	15 (3)
2100-2199	Tobacco Products		
2200-2299	Textile Mill Products		
2300-2399	Apparel, Textile Products		
2400-2499	Lumber and Wood Products		
2500-2599	Furniture and Fixtures		
2600-2699	Paper and Allied Products		
2700-2799	Printing and Publishing		
2900-2999	Petroleum, Refining, Related	5 (1)	4 (1)
3000-3099	Rubber, Miscellaneous Plastic Products	16 (3)	16 (3)
3100-3199	Leather, Leather Products		
3200-3299	Stone, Clay, Glass, Concrete	1 (<1)	1 (<1)
3300-3399	Primary Metal Industries	5 (1)	5 (1)
3400-3499	Fabricated Metal Products		
3500-3599	Machinery, Except Electricals	2 (<1)	2 (<1)
3600-3699	Electrical, Electronic, Machinery		
3700-3799	Transportation Equipment	1 (<1)	1 (<1)
3800-3899	Measuring, Controlling, and Analyzing Instruments; Photographic, Medical and Optical Goods; Watches and Clocks	3 (<1)	3 (<1)

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TABLE 4 (continued)

SIC Code	Non-Manufacturing Product Type	Responses Number (Percentage) 1981	1982
3900-3999	Miscellaneous Manufacturing	1 (<1)	1 (<1)
1000-1499	Mining	1 (<1)	1 (<1)
4000-4999	Transportation, Communication, and Utilities	12 (2)	12 (2)
5000-5199	Wholesale Trade	2 (<1)	3 (<1)
9100-9799	Public Administration	1 (<1)	1 (<1)
9900-9999	Nonclassifable Establishments	2 (<1)	2 (<1)

[1] Numbers in parentheses represent a rounded percentage using the number of responding plants as the divisor.

TABLE 5

SUMMARY OF RESPONDENT PLANT TYPES

	Plant Categories			
Year	Research	Manufacturing	Research and Manufacturing	Unaccounted For[1]
1981	9 (2)[2]	349 (65)	158 (30)	20 (4)
1982	10 (2)	339 (64)	160 (30)	19 (4)

1 Unaccounted for represents the number of plants which did not respond to this question.

2 Number in parentheses represents a rounded percentage.

Table 6 indicates the hazardous waste generator status of the respondents. Eighty-four percent were hazardous waste generators, six percent had small quantity generator status, and approximately ten percent indicated that they did not generate hazardous waste.

Table 7 indicates the current or pending RCRA Part B designation of the responding facilities. Over half of the plants (56 percent) were designated storage facilities, 34 percent treated hazardous waste, and approximately 18 percent had disposal status.[2] Forty percent of the respondents indicated they did not have or did not plan to apply for treatment, storage, or disposal permits.

Table 8 summarizes the waste treatment methods used by those surveyed. Thermal, chemical, and physical treatment showed similar frequencies of utilization, ranging between 15 and 20 percent (Table 8). Biological treatment was less common (five percent), and approximately 63 percent of the respondents indicated that they did not treat hazardous waste. This figure is consistent with the response in Table 7 which indicated that only 34 percent of the respondents had Part B treatment status.

Table 9 displays the frequency of response to the number of hazardous waste incinerators operated by a plant. Eighty-four percent of the respondents did not operate hazardous waste incinerators. The number of incinerators per plant ranged from one to seven.

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2 An individual facility may have more than one Part B designation so the sum of percentages is larger than 100 percent.

TABLE 6

SUMMARY OF RESPONDENTS' HAZARDOUS WASTE GENERATOR STATUS

	Generator Status			
Year	Hazardous Waste Generator	Small Quantity Generator	Non-Hazardous Generator	Unaccounted For[1]
1981	451 (84)[2]	33 (6)	49 (9)	3 (<1)
1982	442 (84)	31 (6)	51 (10)	4 (<1)

1 Unaccounted for represents the number of plants which did not respond to this question.

2 Number in parentheses represents a rounded percentage.

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TABLE 7

SUMMARY OF RESPONDENTS' PART B DESIGNATION
(NUMBER AND PERCENTAGE)

	Part B Designation			
Year	Treatment	Storage	Disposal	Not Applicable
1981	181 (34)[1]	298 (56)	95 (18)	212 (40)
1982	179 (34)	295 (56)	91 (17)	209 (40)

[1] Numbers in parentheses represent rounded totals which may sum to more than 100 percent as an individual facility may have more than one Part B designation.

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TABLE 8

SUMMARY OF RESPONDENTS'
HAZARDOUS WASTE TREATMENT METHODS[1]
(NUMBER AND PERCENTAGE)

	Treatment Method				
Year	Thermal	Chemical	Physical	Biological	None
1981	90 (17)[2]	104 (19)	84 (16)	26 (5)	339 (63)
1982	92 (17)	104 (20)	78 (15)	29 (5)	327 (62)

1 These methods do not include the treatment of hazardous wastewaters.

2 Numbers in parentheses represent rounded totals which may sum to more than 100 percent as an individual facility may utilize more than one waste treatment method.

TABLE 9

SUMMARY OF THE NUMBER OF
HAZARDOUS WASTE INCINERATORS AMONG RESPONDENTS

	Number of Plants Responding	
Number of Incinerators	1981	1982
Unaccounted for	4	5
0	454	443
1	50	52
2	15	15
3	7	7
4	4	4
5	1	1
6	0	0
7	1	1
Number of Incinerators	129	131

Table 10 summarizes the type and number of disposal facilities among the respondents for both survey years. In general, less than ten percent of plants utilized any one type of disposal method. Surface impoundments were the most common type of disposal facility followed by underground injection and landfills. Land application was the least reported method of disposal.

Summary of Reported Quantities

This section provides a tabulated summary of the reported waste quantities. More detailed descriptive statistics for each of the tables in this section have been provided in Appendix A. The appended tables include measures of dispersion (e.g., standard deviation and coefficient of variation) and have been given associated table numbers for easy reference (e.g., Table 11A in the appendix corresponds to Table 11 in the text).

Table 11 provides descriptive statistics for the hazardous waste generation categories of interest for both 1981 and 1982. Among the three RCRA wastes (i.e., listed, characteristic, and mixture), characteristic waste proved to be the largest component. Of the total quantity of hazardous waste generated (i.e., listed, characteristic, mixture, and state hazardous), state hazardous waste was the largest contributor to the total. Because state hazardous waste proved to be such an important component, additional information on state waste will be discussed later in the Trend Analysis section.

TABLE 10

SUMMARY OF TYPE AND NUMBER OF DISPOSAL FACILITIES AMONG RESPONDENTS[1]

	Frequency of Response																			
	1981										1982									
Facility Type	0	1	2	3	4	5	6	7	9	Total	0	1	2	3	4	5	6	7	9	Total
Underground Injection	485	14	12	5		2				63	479	13	11	5		2				60
Landfill	493	24	5	1						37	485	25	5	1						38
Land Application	511	2								2	503	2								2
Surface Impoundment[2]	479	34	4		2		3	1	2	93	474	31	4		2		3	1	2	90
Waste Piles	508	6								6	498	6								6
Other	478	13	2							17	473	14	2							18

1 All facilities are on-site and exclude wastewater disposal facilities.

2 The surface impoundments represent only disposal facilities, not storage facilities.

TABLE 11

SUMMARY OF WASTE GENERATION DATA (TONS)
(1981)

Variable	N[1]	Mean	Sum	Percent of Total
Listed Hazardous Waste	536	2,248	1,204,997	17.1
Characteristic Hazardous Waste	536	4,375	2,345,484	33.2
Mixture Hazardous Waste	534	774	413,553	5.9
State Hazardous Waste	536	5,775	3,095,931	43.9
TOTAL HAZARDOUS WASTE[2]	536	13,171	7,059,965	
Hazardous Wastewater	536	1,336,340	716,278,579	
Bevill Amendment Waste	533	147,388	78,558,205	
Small Generator Waste	531	0.1	76	
Non-Hazardous Process Waste	535	21,916	11,725,368	

1 N represents the number of plants which reported a value (i.e., zero or a quantity) for this variable.

2 Total hazardous waste includes: listed, characteristic, mixture, and state hazardous wastes.

TABLE 11 (continued)

(1982)

Variable	N[1]	Mean	Sum	Percent of Total
Listed Hazardous Waste	527	792	417,762	8.4
Characteristic Hazardous Waste	527	3,755	1,979,265	39.8
Mixture Hazardous Waste	527	572	301,692	6.1
State Hazardous Waste	527	4,309	2,271,206	45.7
TOTAL HAZARDOUS WASTE[2]	528	9,412	4,969,925	
Hazardous Wastewater	526	1,333,316	701,324,571	
Bevill Amendment Waste	524	78,595	41,183,993	
Small Generator Waste	523	0.2	90	
Non-Hazardous Process Waste	527	19,822	10,446,634	

1 N represents the number of plants which reported a value (i.e., zero or a quantity) for the variable.

2 Total hazardous waste includes: listed, characteristic, mixture, and state hazardous wastes.

The total quantity of hazardous wastewater generated proved to be two orders of magnitude greater than the total for solid hazardous waste (Table 11). Bevill Amendment wastes were an order of magnitude greater than the solid hazardous waste total. The approximately 30 small generator plants produced an average of less than three tons of RCRA hazardous waste per year. Non-hazardous process waste exceeded hazardous waste generation in both years, but was within the same order of magnitude.

Every waste generation category, with the exception of small generator waste, exhibited a substantial decrease between 1981 and 1982. This is consistent with the observed decrease in total value-of-shipment for the same period.

Table 12 displays descriptive statistics for use, reuse, recycle, and reclaimed waste practices for 1981 and 1982. The total quantity of hazardous material recycled in both years exceeded the reported total quantity of hazardous waste (RCRA and state) generated (see Table 11). On-site recycling proved to be the predominant practice. The "other" method category was the largest component of the total recycled quantity, with burned as fuel being second in importance followed by reuse as raw process material, and then treatment prior to reclamation. Direct placement was virtually not practiced among the respondents (Table 12). RCRA characteristic waste accounted for over 90 percent of the hazardous waste recycled in both years. The total quantities of waste recycled in 1981 and 1982 were virtually identical.

Table 13 summarizes the response for treatment of hazardous waste. Chemical, physical, and biological treatment greatly exceeded the quantity of waste which was thermally treated

SUMMARY OF USE, REUSE, RECYCLE, AND RECLAIM PRACTICES (TONS)
(1981)

Method	On-Site	% Total	Off-Site	% Total	Commercial	% Total	Other	% Total	Total	% of Grand Total
Direct Placement: (Listed, Mixture, & State Hazardous)	0	—	0	—	5,300	100	0	—	5,300	<0.1
Direct Placement: (Characteristic)	0	—	0	—	48	100	0	—	48	<0.1
Burned as Fuel: (Listed, Mixture, & State Hazardous)	842,282	98.4	546	<0.1	10,906	1.3	1,778	<0.1	855,512	8.5
Burned as Fuel: (Characteristic)	686,089	97.8	1,965	0.2	13,426	1.9	70	<0.1	701,550	7.0
Reused as Raw Process Material: (Listed, Mixture, & State Hazardous)	71,178	93.6	1,951	2.6	2,917	3.8	0	—	76,046	0.8
Reused as Raw Process Material: (Characteristic)	251,117	56.3	135,779	30.4	59,033	13.2	0	—	445,929	4.5
Treated & Reclaimed: (Listed, Mixture, & State Hazardous)	95,360	86.4	4,216	3.8	10,812	9.8	0	—	110,388	1.1
Treated & Reclaimed: (Characteristic)	303,206	92.0	10	<0.1	26,437	8.0	0	—	329,653	3.3
Other: (Listed, Mixture, & State Hazardous)	3,613	44.8	0	—	4,451	55.2	0	—	8,064	<0.1
Other: (Characteristic)	7,465,345	99.9	0	—	6,444	<0.1	1,792	<0.1	7,473,581	74.7
Totals:	9,718,190	97.1	144,467	1.4	139,774	1.4	3,640	<0.1	10,006,071	

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TABLE 12 (continued)

(1982)

Method	On-Site	% Total	Off-Site	% Total	Commercial	% Total	Other	% Total	Total	% of Grand Total
Direct Placement: (Listed, Mixture, & State Hazardous)	0	—	0	—	4,609	100	0	—	4,609	<0.1
Direct Placement: (Characteristic)	0	—	0	—	635	100	0	—	635	<0.1
Burned as Fuel: (Listed, Mixture, & State Hazardous)	131,273	92.2	969	0.7	8,722	6.1	1,471	1.0	142,435	1.4
Burned as Fuel: (Characteristic)	564,524	97.6	1,239	0.2	11,296	2.0	1,583	0.3	578,642	5.7
Reused as Raw Process Material: (Listed, Mixture, & State Hazardous)	70,783	90.8	1,867	2.4	4,841	6.2	480	0.6	77,971	0.8
Reused as Raw Process Material: (Characteristic)	232,718	60.4	117,816	30.6	34,839	9.0	0	—	385,373	3.8
Treated & Reclaimed: (Listed, Mixture, & State Hazardous)	96,177	85.5	2,243	2.0	13,851	12.3	204	0.2	112,475	1.1
Treated & Reclaimed: (Characteristic)	233,821	86.9	10	<0.1	35,142	13.1	0	—	268,973	2.7
Other: (Listed, Mixture, & State Hazardous)	3,255	98.6	0	—	45	1.4	0	—	3,300	<0.1
Other: (Characteristic)	8,534,999	99.9	0	—	9,551	0.1	1,480	<0.1	8,546,030	84.4
Totals:	9,867,550	97.5	124,144	1.2	123,531	1.2	5,218	.0.1	10,120,443	

TABLE 13

SUMMARY OF HAZARDOUS WASTE TREATMENT PRACTICES (TONS)

Method	On-Site	% Total	Off-Site	% Total	Commercial	% Total	Total	% of Grand Total
					1981			
Incineration	528,900	89.0	11,953	2.0	53,749	9.0	594,602	29.2
Treatment[1]	1,366,767	94.7	6,916	0.5	69,388	4.8	1,443,071	70.8
Totals	1,895,667	93.0	18,869	0.9	123,137	6.0	2,037,673	
					1982			
Incineration	409,107	89.2	8,013	1.7	41,521	9.1	458,641	14.1
Treatment[1]	1,193,289	42.7	7,829	0.3	1,592,416	57.0	2,793,534	85.9
Totals	1,602,396	49.3	15,842	0.5	1,633,937	50.2	3,252.175	

[1] Treatment refers to chemical, physical, or biological treatment of hazardous waste, excluding hazardous wastewater.

(incinerated) in both years. In 1981, on-site treatment was the primary practice; however, in 1982 on-site and commercial treatment were practiced equally (in terms of tons treated). Very little hazardous waste was taken to off-site, company-owned treatment facilities.

Table 14 provides descriptive statistics for reported hazardous waste disposal practices for 1981 and 1982. The total quantity disposed of slightly exceeded the value of total hazardous waste generated (Table 11) for both years. This difference is largely due to the fact that several plants erroneously included wastewater in their response to the disposal question's underground injection category. However, these same plants correctly excluded wastewater from their generation quantities, therefore, disposal exceeded generation for these plants.

Underground injection was the predominant method of disposal with landfill disposal and surface impoundments being second and third, respectively. Waste piles, land application, and ocean disposal were of much less importance as disposal methods. The "other" category accounted for approximately 18 to 14 percent of the total waste disposed of in 1981 and 1982, respectively.

Similar to previously observed trends, the amount of waste disposed of generally decreased in 1982 for each category.

Table 15 provides a comparison of the amount of hazardous waste (RCRA and state) disposed of on an as-is ton and dry ton basis. The dry ton quantities were approximately 31 percent and 18 percent of the as-is ton quantities for 1981 and 1982, respectively. The most aqueous wastes were disposed of by

TABLE 14

SUMMARY OF HAZARDOUS WASTE DISPOSAL PRACTICES[1] (TONS)[2]
(1981)

Method	On-Site	% Total	Off-Site	% Total	Commercial	% Total	Total	% of Grand Total
Landfill	1,120,131	72.7	17,021	1.1	403,287	26.2	1,540,439	20.4
Surface Impoundment	154,736	30.3	347,778	68	8,829	1.7	511,343	6.8
Waste Piles	0	—	0	—	0	—	0	—
Land Application	432	1.7	0	—	25,305	98.3	25,737	0.3
Underground Injection	3,929,114	97.5	0	—	99,133	2.5	4,028,247*	53.5
Ocean Dumping	0	—	0	—	36,000	100	36,000	0.5
Other	1,390,566	99.8	0	—	2,173	0.2	1,392,739	18.5
Totals	6,594,979	87.5	364,799	4.8	574,727	7.6	7,534,505	

1 Quantities include state and RCRA hazardous waste.

2 "As-is" tons (includes water).

* See Addendum Page:Note 2

TABLE 14 (continued)

(1982)

Method	On-Site	% Total	Off-Site	% Total	Commercial	% Total	Total	% of Grand Total
Landfill	452,777	57.1	10,417	1.3	329,267	41.5	792,461	14.0
Surface Impoundment	114,679	24.2	354,867	74.9	3,958	0.8	473,504	8.3
Waste Piles	0	—	0	—	6	100	6	<0.1
Land Application	337	57.2	0	—	252	42.8	589	<0.1
Underground Injection	3,404,778	95.3	0	—	169,096	4.7	3,573,874	63.0
Ocean Dumping	0	—	0	—	24,000	100	24,000	0.4
Other	806,992	99.7	0	—	2,617	0.3	809,609*	14.3
Totals	4,779,563	84.2	365,284	6.4	529,196	9.3	5,674,043	

* See Addendum Page:Note 3

SUMMARY OF DISPOSAL QUANTITIES[1] ON A DRY TON BASIS

Method	(1) As-Is Total 1981	(1) As-Is Total 1982	(2) Dry Wgt Total 1981	(2) Dry Wgt Total 1982	Ratio (2)/(1) 1981	Ratio (2)/(1) 1982
Landfill	1,540,439	792,461	1,424,003	585,726	0.92	0.74
Surface Impoundment	859,121	473,504	36,050	21,776	0.04	0.05
Waste Piles	0	6	0	0	--	--
Land Application	25,737	589	3,539	300	0.14	0.51
Underground Injection	4,028,247	3,573,874	369,229	281,691	0.09	0.08
Ocean	36,000	24,000	0	0	--	--
Total	6,489,544	4,864,434	1,832,821	889,493	0.31	0.18
Other	1,392,739	809,609	--	--	--	--
TOTAL	7,882,283	5,674,043	1,832,821	889,493	--	--

[1] Quantities include state and RCRA hazardous wastes.

underground injection and in surface impoundments. The most solid materials were sent to landfills (Table 15). On a dry ton basis, the importance of landfills exceeds underground injection as a disposal practice. Also, the reduction in waste disposal between 1981 and 1982 is relatively greater when dry weight quantities are compared.

Table 16 displays the type of hazardous wastewater treatment/neutralization method used by the respondents in 1981 and 1982. Thirty-one percent treated or neutralized hazardous wastewater in tanks and 11 percent neutralized their wastewater in impoundments.

Table 17 provides descriptive statistics for four hazardous wastewater disposal categories. Most of the wastewater for 1981 and 1982 was sent to NPDES facilities. POTW facilities received less than ten percent of the total in both years. Deep wells received approximately half as much hazardous wastewater as POTW facilities. The "other" category was to be used to report wastewater which was neutralized and rendered non-hazardous. Assuming this was the case, this quantity represents somewhat less than ten percent of the total quantity of hazardous wastewater reported (Table 11).

Table 18 provides a summary for the treatment/disposal and recycling of hazardous waste from outside sources. The quantity of waste treated or disposed of from other plants was relatively similar for company-owned and non-company-owned sources in 1981. However, non-company plants contributed most of the outside waste which was treated or disposed of in 1982. Non-company-owned plants were the predominant source of outside waste which was recycled in both 1981 and 1982. The

TABLE 16

SUMMARY OF
HAZARDOUS WASTEWATER NEUTRALIZATION
METHODS

	Number of Plants Responding					
	1981			1982		
nod	Yes	No	Uncounted	Yes	No	Uncounted
atment/ tralization Tanks	164 (31)[1]	370 (69)	2 (<1)	164 (31)	370 (70)	4 (<1)
tralization Impoundments	60 (11)	475 (89)	1 (<1)	60 (11)	475 (90)	3 (<1)

Number in parentheses represents a rounded percentage.

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TABLE 17

SUMMARY OF HAZARDOUS WASTEWATER DISPOSAL (TONS)
(1981)

Variable	N[1]	Mean	Sum	Percent of Total
NPDES Facility	534	1,117,430	596,707,975	83.3
POTW Facility	536	73,951	39,637,847	5.5
Deep Well Injection	535	34,767	18,600,677	2.6
Other	527	116,561	61,428,030	8.6
Total			716,374,530	
Deep Well Dry Tons	532	1,996	1,062,209	

1 N represents the number of plants which reported a value (i.e., zero or a quantity) for this variable.

TABLE 17 (continued)

(1982)

Variable	N[1]	Mean	Sum	Percent of Total
NPDES Facility	525	1,114,348	585,032,763	83.4
POTW Facility	525	77,206	40,533,409	5.8
Deep Well Injection	526	34,798	18,303,865	2.6
Other	525	109,233	57,347,526	8.2
Total			701,217,560	
Deep Well Dry Tons	526	1,536	808,359	

[1] N represents the number of plants which reported a value (i.e., zero or a quantity) for this variable.

TABLE 18

SUMMARY OF HAZARDOUS WASTE TREATMENT/DISPOSAL AND RECYCLING FROM OTHER SOURCES (TONS) (1981)

Variable	N[1]	Sum	Percent of Total
Treatment/Disposal:			
Company-Owned Source	534	141,372	46.1
Non-Company-Owned Source	534	165,178	53.9
Total		306,550	
Use, Reuse, Recycle, Reclaim:			
Company-Owned Source	534	165,150	19.8
Non-Company-Owned Source	534	667,964	80.2
Total		883,114	

[1] N represents the number of plants which reported a number (i.e., zero or a quantity) for this variable.

TABLE 18 (continued)

(1982)

Variable	N[1]	Sum	Percent of Total
Treatment/Disposal:			
Company-Owned Source	527	49,022	18.5
Non-Company-Owned Source	527	215,451	81.5
Total		264,473	
Use, Reuse, Recycle, Reclaim:			
Company-Owned Source	526	157,751	20.5
Non-Company-Owned Source	528	651,304	80.5
Total		809,055	

[1] N represents the number of plants which reported a value (i.e., zero or a quantity) for this variable.

overall total of waste which was treated/ disposed/recycled from other sources exhibited relatively little change between 1981 and 1982.

Table 19 exhibits the quantity of waste shipped in 1981 and 1982 by the two shipment methods. Bulk waste quantities were an order of magnitude greater in both years. The amount of hazardous waste shipped decreased in 1982, especially in the bulk shipment category.

Trend Analysis

Table 20 provides descriptive statistics comparing the quantity of state-designated hazardous waste with RCRA hazardous waste and the total amount of hazardous waste generated (RCRA and and state) for all respondents that reported a state hazardous waste. The comparison is partitioned by state and year.

Nineteen of the 40 states represented in the survey had plants which generated a state hazardous waste. Plants in 11 states (Alabama, Delaware, Indiana, Maryland, Massachusetts, Michigan, Maryland, New York, Oklahoma, Pennsylvania, Washington) produced relatively small quantities (<1,000 tons) of state hazardous waste. However, plants in Louisiana produced a substantial quantity of state hazardous waste which made up 50 percent or more of the total hazardous waste generated in both years. Tennessee also yielded a large quantity of state waste, but since this quantity was produced by a single plant it is probably not representative of the importance of state regulations to the typical plant within that state.

TABLE 19

SUMMARY OF HAZARDOUS WASTE SHIPMENT METHODS[1]
(TONS)

Variable	N[2]	Mean	Sum	Percent of Total
1981				
Bulk Waste	532	1,248	664,224	88.1
Containerized Waste (<110 gallons)	533	168	90,011	11.9
Total			754,235	
1982				
Bulk Waste	527	875	461,639	85.3
Containerized Waste (<110 gallons)	527	150	79,364	14.7
Total			541,003	

1 The reported quantities include listed, characteristic, mixture, and state hazardous wastes.

2 N represents the number of plants which reported a value (i.e., zero or a quantity) for this variable.

TABLE 20

SUMMARY OF STATE-DESIGNATED
HAZARDOUS WASTE GENERATION (TONS)

	Year	N[1]	n[2]	Mean	Sum	Percent of Total
				Alabama		
RCRA Waste	1981	—	—			
	1982	18	1	1,197	21,554	100
State Waste	1981	—	—			
	1982	18	1		6	<1
Total Waste[3]	1981	—	—			
	1982	18	1	1,198	21,560	
				California		
RCRA Waste	1981	37	17	3,945	145,972	91
	1982	36	16	2,152	77,495	87
State Waste	1981	37	17	414	15,319	9
	1982	36	16	319	11,479	13
Total Waste	1981	37	17	4,359	161,291	
	1982	36	16	2,471	88,974	
				Delaware		
RCRA Waste	1981	8	1	1,240	9,922	99
	1982	8	1	647	5,175	99
State Waste	1981	8	1	8	65	1
	1982	8	1	6	48	1
Total Waste	1981	8	1	1,248	9,987	
	1982	8	1	653	5,223	

[1] N represents the number of survey respondents from that state.

[2] n represents the number of plants in the state which reported a state hazardous waste.

[3] Total Waste represents the total amount of hazardous waste (i.e., RCRA waste plus state waste) generated by all respondents from that state, excluding hazardous wastewater.

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TABLE 20 (continued)

	Year	N[1]	n[2]	Mean	Sum	Percent of Total
				Illinois		
RCRA Waste	1981	28	5	1,503	42,093	89
	1982	26	3	1,527	39,705	87
State Waste	1981	28	5	191	5,346	11
	1982	26	3	225	5,865	13
Total Waste[3]	1981	28	5	1,694	47,439	
	1982	26	3	1,752	45,570	
				Indiana		
RCRA Waste	1981	10	1	12,162	121,630	100
	1982	10	1	11,223	112,235	100
State Waste	1981	10	1	33	335	<1
	1982	10	1	46	452	<1
Total Waste	1981	10	1	12,196	121,965	
	1982	10	1	11,269	112,687	
				Louisiana		
RCRA Waste	1981	38	18	26,304	999,571	37
	1982	36	17	27,248	980,951	50
State Waste	1981	38	18	43,881	1,667,484	63
	1982	36	17	26,860	966,954	50
Total Waste	1981	38	18	70,185	2,667,055	
	1982	36	17	54,108	1,947,905	

[1]N represents the number of survey respondents from that state.

[2]n represents the number of plants in the state which reported a state hazardous waste.

[3]Total Waste represents the total amount of hazardous waste (i.e., RCRA waste plus state waste) generated by all respondents from that state, excluding hazardous wastewater.

TABLE 20 (continued)

	Year	N[1]	n[2]	Mean	Sum	Percent of Total
				Maryland		
RCRA Waste	1981	5	3	24,995	124,979	100
	1982	5	3	20,801	104,009	100
State Waste	1981	5	3	16	78	<1
	1982	5	3	5	21	<1
Total Waste[3]	1981	5	3	25,011	125,057	
	1982	5	3	20,806	104,030	
				Massachusetts		
RCRA Waste	1981	6	1	362	2,169	99
	1982	5	2	203	1,019	83
State Waste	1981	6	1	3	18	1
	1982	5	2	43	215	17
Total Waste	1981	6	1	365	2,187	
	1982	5	2	246	1,234	
				Michigan		
RCRA Waste	1981	20	2	50,021	1,000,429	100
	1982	21	3	13,854	290,935	100
State Waste	1981	20	2	8	158	<1
	1982	21	3	21	439	<1
Total Waste	1981	20	2	50,029	1,000,587	
	1982	21	3	13,875	291,374	

[1]N represents the number of survey respondents from that state.

[2]n represents the number of plants in the state which reported a state hazardous waste.

[3]Total Waste represents the total amount of hazardous waste (i.e., RCRA waste plus state waste) generated by all respondents from that state, excluding hazardous wastewater.

TABLE 20 (continued)

	Year	N[1]	n[2]	Mean	Sum	Percent of Total
				Missouri		
RCRA Waste	1981	12	4	1,786	21,436	100
	1982	12	2	1,422	17,066	100
State Waste	1981	12	4	6	76	<1
	1982	12	2	3	39	<1
Total Waste[3]	1981	12	4	1,792	21,512	
	1982	12	2	1,425	17,105	
				New Jersey		
RCRA Waste	1981	50	13	2,877	143,875	98
	1982	49	17	2,105	103,145	99
State Waste	1981	50	13	57	2,869	2
	1982	49	17	28	1,409	1
Total Waste	1981	50	13	2,934	146,744	
	1982	49	17	2,133	104,554	
				New York		
RCRA Waste	1981	19	1	3,190	60,622	99
	1982	20	6	2,558	51,162	99
State Waste	1981	19	1	17	318	1
	1982	20	6	14	278	1
Total Waste	1981	19	1	3,207	60,940	
	1982	20	6	2,572	51,440	

[1]N represents the number of survey respondents from that state.

[2]n represents the number of plants in the state which reported a state hazardous waste.

[3]Total Waste represents the total amount of hazardous waste (i.e., RCRA waste plus state water) generated by all respondents from that state, excluding hazardous wastewater.

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TABLE 20 (continued)

	Year	N[1]	n[2]	Mean	Sum	Percent of Total
				Ohio		
RCRA Waste	1981	31	2	767	23,774	68
	1982	30	2	489	14,661	77
State Waste	1981	31	2	357	11,067	32
	1982	30	2	145	4,358	23
Total Waste[3]	1981	31	2	1,124	34,841	
	1982	30	2	634	19,019	
				Oklahoma		
RCRA Waste	1981	3	1	162	487	74
	1982	3	1	94	282	43
State Waste	1981	3	1	57	170	26
	1982	3	1	123	371	57
Total Waste	1981	3	1	219	657	
	1982	3	1	217	653	
				Pennsylvania		
RCRA Waste	1981	16	1	134	2,146	94
	1982	16	1	138	2,203	97
State Waste	1981	16	1	8	131	6
	1982	16	1	4	72	3
Total Waste	1981	16	1	142	2,277	
	1982	16	1	142	2,275	

[1] N represents the number of survey respondents from that state.

[2] n represents the number of plants in the state which reported a state hazardous waste.

[3] Total Waste represents the total amount of hazardous waste (i.e., RCRA waste plus state waste) generated by all respondents from that state, excluding hazardous wastewater.

TABLE 20 (continued)

	Year	N[1]	n[2]	Mean	Sum	Percent of Total
				South Carolina		
RCRA Waste	1981	11	7	197	2,162	54
	1982	10	7	46	463	33
State Waste	1981	11	7	167	1,840	46
	1982	10	7	95	950	67
Total Waste[3]	1981	11	7	364	4,002	
	1982	10	7	141	1,413	
				Tennessee		
RCRA Waste	1981	15	1	4,527	67,919	5
	1982	15	1	2,945	44,171	4
State Waste	1981	15	1	90,000	1,350,000	95
	1982	15	1	80,533	1,208,000	96
Total Waste	1981	15	1	94,527	1,417,919	
	1982	15	1	83,478	1,252,171	
				Texas		
RCRA Waste	1981	83	32	11,303	938,197	96
	1982	83	30	8,356	693,545	91
State Waste	1981	83	32	484	40,135	4
	1982	83	30	835	69,326	9
Total Waste	1981	83	32	11,787	978,332	
	1982	83	30	9,191	762,871	

[1]N represents the number of survey respondents from that state.

[2]n represents the number of plants in the state which reported a state hazardous waste.

[3]Total Waste represents the total amount of hazardous waste (i.e., RCRA waste plus state waste) generated by all respondents from that state, excluding hazardous wastewater.

TABLE 20 (continued)

	Year	N[1]	n[2]	Mean	Sum	Percent of Total
			Washington			
RCRA Waste	1981	5	2	1,269	6,343	92
	1982	5	2	1,327	6,633	88
State Waste	1981	5	2	103	519	8
	1982	5	2	184	924	12
Total Waste[3]	1981	5	2	1,372	6,862	
	1982	5	2	1,511	7,557	

[1]N represents the number of survey respondents from that state.

[2]n represents the number of plants in the state which reported a state hazardous waste.

[3]Total Waste represents the total amount of hazardous waste (i.e., RCRA waste plus state waste) generated by all respondents from that state, excluding hazardous wastewater.

State hazardous waste production accounted for ten percent or greater of the total hazardous waste quantity in Illinois, Louisiana, Ohio, Oklahoma, South Carolina, and Tennessee.

Table 21 presents the results of a series of Student's t-tests run on the paired 1981 and 1982 observations for several waste categories. This test compared the mean 1981 value with the mean 1982 value for each variable shown. Statistically significant results are indicated when the PR > T value is less than 0.05.

Eight significant (P <0.05) differences between 1981 and 1982 values were found (note asterisk values in Table 21). In all cases, the 1981 value was greater than the 1982 value as exhibited by the negative mean values which represent the 1982 mean minus the 1981 mean value.

Four of the significant differences occurred in waste generation categories for characteristic waste, hazardous wastewater, non-hazardous process waste, and total hazardous waste production. Other statistically significant differences were observed in the amount of hazardous wastewater sent to NPDES facilities, the quantity of waste incinerated, underground injection of waste, and the amount of waste shipped in bulk.

Several other inter-year comparisons exhibited relatively large mean differences (e.g., state hazardous waste), but did not prove statistically significant. The fact that most of the mean differences were negative is consistent with the general observation that most reported waste quantities were lower in 1982 than 1981.

TABLE 21

PAIRED COMPARISONS OF 1981 VERSUS 1982 QUANTITIES

Variable	N	Mean Difference (1982-1981)	Std Error of Mean	T Value	Probability of T Value
Listed Waste	523	-1505.34	1321.87	-1.14	0.2553
Characteristic Waste	523	-691.88	240.53	-2.88	0.0042*
Mixture Waste	521	-238.05	154.86	-1.54	0.1249
State Waste	523	-1577.20	896.64	-1.76	0.0792
Hazardous Wastewater	522	-28647.52	13897.10	-2.06	0.0398*
Bevill Amendment Waste	519	-70923.33	50117.44	-1.42	0.1576
Small Generator Waste	516	0.02	0.07	0.31	0.7532
Non-Hazardous Process Waste	522	-1640.69	760.08	-2.16	0.0313*
Total Hazardous Waste	524	-4001.53	1636.82	-2.44	0.0148*
NPDES Facility	520	-22452.33	9498.05	-2.36	0.0185*
POTW Facility	521	1718.92	7179.90	0.24	0.8109
Deep Well Injection	521	-569.69	1748.22	-0.33	0.7447
Deep Well Dry Tons	518	-490.05	545.82	-0.90	0.3697
Other Hazardous Wastewater	513	-8219.93	6610.69	-1.24	0.2143
Direct Placement: Listed, Mixture, and State Hazardous	520	-1412.32	1334.72	-1.06	0.2905
Direct Placement: Characteristic	523	1.12	1.06	1.05	0.2922
Burned as Fuel: Listed, Mixture, and State Hazardous	524	-1360.83	1298.26	-1.05	0.2950
Burned as Fuel: Characteristic	522	-235.45	123.53	-1.91	0.0572
Used as Raw Material: Listed, Mixture, and State Hazardous	524	2.68	10.06	0.27	0.7899
Used as Raw Material: Characteristic	522	-114.93	64.10	0.27	0.0736
Treated and Reclaimed: Listed, Mixture, and State Hazardous	523	2.98	9.10	0.44	0.6618
Treated and Reclaimed: Characteristic	523	-116.02	127.48	-0.91	0.3632
Other UR^3 Waste: Listed, Mixture, and State Hazardous	523	-2.11	1.61	-1.31	0.1894
Other UR^3 Waste: Characteristic	523	2043.57	10201.19	0.20	0.8413
Incineration	523	-254.86	74.96	-3.40	0.0007*

TABLE 21 (continued)

Variable	N	Mean Difference (1982-1981)	Std Error of Mean	T Value	Probability of T Value
Treatment	520	2573.71	2934.58	0.88	0.3809
Landfill: Dry Tons	510	-1648.74	1364.59	-1.21	0.2275
Surface Impoundment: As-Is Tons	520	533.00	687.57	0.78	0.4386
Surface Impoundment: Dry Tons	513	-19.99	16.02	-1.25	0.2125
Waste Pile: As-Is Tons	521	0.01	0.01	1.00	0.3178
Waste Pile: Dry Tons	513	0.00	0.00		
Land Application: As-Is Tons	521	-48.26	48.57	-0.99	0.3208
Land Application: Dry Tons	512	-6.32	6.32	-1.00	0.3178
Underground Injection: As-Is Tons	522	-869.51	424.64	-2.05	0.0411*
Underground Injection: Dry Tons	512	-170.01	96.38	-1.76	0.0783
Ocean Disposal: As-Is Tons	521	-23.03	23.03	-1.00	0.3178
Ocean Disposal: Dry Tons	514	0.00	0.00		
Other Disposal	520	-1121.39	838.69	-1.34	0.1818
Treatment/Disposal from Company Sources	521	-177.25	190.09	-0.93	0.3515
Treatment/Disposal from Non-Company Sources	521	96.49	108.42	0.89	0.3739
UR[3] from Company Sources	520	-14.22	63.66	-0.22	0.8232
UR[3] from Non-Company Sources	522	-31.91	96.75	-0.33	0.7416
Shipment Method: Bulk	519	-406.79	177.18	-2.30	0.0221*
Shipment Method: Container	520	-19.10	18.00	-1.06	0.2892
Total On-Site Disposal	522	-3335.38	1826.50	-1.83	0.0684
Total Off-Site Disposal	519	-0.84	19.13	-0.04	0.9646
Total Commercial Disposal	521	2641.78	2929.62	0.90	0.3676
Total Disposal	522	-1477.17	3368.18	-0.44	0.6612
Total On-Site UR[3]	523	-13960.31	8725.30	-1.60	0.1102
Total Off-Site UR[3]	523	-38.78	24.83	-1.56	0.1190
Total Commercial UR[3]	523	-56.98	54.34	-1.05	0.2949
Total Other UR[3]	523	-1.32	4.12	-0.32	0.7480
Total UR[3]	524	-13992.81	8711.45	-1.61	0.1088

1 The asterisk indicates that a statistically significant difference (P <0.05) exists between the 1981 and 1982 mean values for this variable.

Extrapolation of Survey Data

Table 22 summarizes the results of regression analyses conducted to determine the relationship between a company's value-of-shipment and four separate waste categories (i.e., waste generation, RCRA waste, disposed waste (as-is and dry tons), and recycled waste). These regressions were established as a means of extrapolating the survey data to industry-wide totals for each of these categories based on the known value-of-shipment for the entire chemical industry. The results proved significant ($P < 0.05$) for each relationship except V-O-S/recycling (Table 22); however, the R^2 value for all of the relationships was low. This indicates that the resultant regression equation would be of little value for estimation of industry-wide recycling totals with any reasonable degree of precision. The general indication is that value-of-shipment does not represent a good predictor (independent variable in the regression) for these parameters.

However, one of the primary objectives of this study was to develop a data base which could be used to estimate industry-wide waste quantities of interest. Therefore, an alternative method was used to "scale-up" the survey data to industry-wide totals. This method involved establishing a simple proportional relationship between the respondents total value-of-shipment and the known value-of-shipment for the entire chemical industry. This technique would produce a "scale-up" factor which could be applied to the survey results to provide a crude estimate of industry-wide totals. The scale-up factors for 1981 and 1982 were:

TABLE 22

SUMMARY OF REGRESSION ANALYSES TO
PREDICT INDUSTRY-WIDE WASTE TOTALS

Year	N	Dependent Variable	Independent Variable	R^2	Prob>F	Intercept	Regression Coefficient
1981	59	Total Waste Generation	V-O-S	0.3559	0.0001	- 6,020	0.00011
1982	58			0.4500	0.0001	-18,698	0.00010
1981	59	RCRA Waste	V-O-S	0.11	0.01	28,931	0.00003
1982	58			0.094	0.02	21,134	0.00002
1981	59	Total Waste Disposal	V-O-S	0.2091	0.0001	-64,854	0.00033
1982	58			0.4600	0.0001	-13,537	0.00011
1981	59	Disposal Dry Tons	V-O-S	0.1199	0.0072	3,352	0.000024
1982	58			0.4207	0.0001	- 4,264	0.000019
1981	59	Total Waste Recycled	V-O-S	0.0287	0.1992	Not significant	
1982	58			0.0254	0.2321		

$$1981 \quad 2.61 = \frac{175.1 \text{ billion (total V-O-S)}}{67.1 \text{ billion (respondents' V-O-S)}}$$

$$1982 \quad 2.99 = \frac{172.4 \text{ billion (total V-O-S)}}{57.6 \text{ billion (respondents' V-O-S)}}$$

Applying these factors to the survey results provides crude industry-wide estimates for the waste categories shown in Table 23.

These estimates warrant cautious interpretation as the results of the regressions indicate that the relationship between the value-of-shipment and each of these parameters is tenuous. Any confidence intervals which might be constructed to bracket the precision of these estimates would be very large with respect to the predicted value.

However, to date any estimate of industry-wide hazardous waste generation and management practices for the chemical industry have been little more than guestimates as data have been unavailable to support an estimate. The data base established by the CMA survey is extensive and the most comprehensive information to date on the chemical industry. The data have been collected and carefully managed under a thorough quality control program. The results are believed to be accurate and the associated findings and conclusions valid within their stated limitations. Therefore, the estimate of industry-wide practices should not necessarily be dismissed because the desired precision cannot be achieved. While they must be interpreted as rough estimates, they represent estimates based on the best information presently available.

TABLE 23

WASTE QUANTITIES EXTRAPOLATED TO INDUSTRY-WIDE TOTALS
(Tons[1])

	1981 Response	Industry-Wide Estimate	1982 Response	Industry-Wide Estimate
RCRA Hazardous Waste Generated	3,964,034	10,300,000	2,698,719	8,100,000
State Hazardous Waste Generated	3,095,931	8,100,000	2,271,206	6,800,000
Used, Reused, Recycled, Reclaimed Waste	10,006,071	26,100,000	10,120,443	30,300,000
Hazardous Waste Disposal (includes state waste)	7,534,505	19,700,000	5,674,043	17,000,000
Hazardous Waste Disposal (dry tons)	1,829,171	4,700,000	883,892	2,600,000
Hazardous Waste Treatment	2,073,673	5,300,000	3,252,175	9,700,000

1 "As-is" tons except where noted.

The predictability of the data base could be markedly enhanced by developing a better predictor parameter for extrapolating the survey results to industry-wide totals. Intuition suggests that a parameter such as "feed stock" or "quantity of products shipped" might be more closely correlated to the independent variables (e.g., RCRA waste) than the value-of-shipment. The utility of this data base would be greatly increased should such information be obtainable.

SECTION 5

SUMMARY AND CONCLUSIONS

The following discussion lists the more salient points of the survey results.

Survey Response

- Forty-six percent (70) of CMA's member companies participated.
- Approximately 44 percent of CMA member plants participated (536 plants in 1981, 528 plants in 1982).
- The respondents represented approximately one-third of the chemical industry's annual value-of-shipment.
- Larger companies appear to be somewhat overly represented in the sample.

Plant Characteristics of Respondents

- Plants fell into three major categories: miscellaneous inorganic chemicals, miscellaneous organic chemicals, and plastic materials and synthetic resins.
- Eighty-four percent of the plants were hazardous waste generators.

- Fifty-six percent of the plants store, 34 percent treat, and 18 percent dispose of hazardous waste. Forty percent did not have TSD status. Several plants have multiple RCRA facilities so the sum of the percentages exceeds 100 percent.

- Eighty-four percent of the plants did not operate a hazardous waste incinerator.

- The most common type of disposal facilities reported were: surface impoundments, underground injection, and landfills.

Summary of Reported Quantities

- Waste quantities displayed a general decrease between 1981 and 1982.

- Characteristic waste proved to be the largest component of the RCRA wastes, but state hazardous waste was the largest waste component overall.

- Plants in 19 of the 40 states represented in the survey reported state hazardous waste.

- Hazardous wastewater exceeded hazardous solid waste by two orders of magnitude.

- Bevill Amendment wastes exceeded total hazardous waste by an order of magnitude.

- The quantity of recycled hazardous waste was greater than the reported total hazardous waste generated.

- The major methods of hazardous waste disposal were underground injection and landfill disposal.

- On-site disposal was the predominant disposal practice.

- Most hazardous wastewater is sent to NPDES facilities.

- Non-company-owned plants were the primary source of hazardous waste recycled from outside sources.

Trend Analysis

- Plants in six states (Illinois, Louisiana, Ohio, Oklahoma, South Carolina, and Tennessee) reported state-designated hazardous waste quantities which were ten percent or more of their total hazardous waste generation.

- Statistical comparisons between years for numerous waste categories indicated a significant decline in waste quantities between 1981 and 1982, especially for waste generation.

Extrapolation of Survey Data

Regression analysis indicated that the relationship between value-of-shipment and each of the quantities to be extrapolated to industry-wide totals was generally low. A crude estimate of industry-wide totals was obtained by applying a proportional "scale-up factor" based on the value-of-shipment. The resultant estimates are rough (cannot be measured with precision), but represent estimates based on the most comprehensive information presently available.

APPENDIX A

DETAILED DESCRIPTIVE STATISTICS OF WASTE QUANTITY RESULTS

TABLE 11A

SUMMARY OF WASTE GENERATION DATA (TONS)
(1981)

Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Listed Hazardous Waste	536	2,248	40,294	1,740	1,204,997	1.623651E+09	1,792
Characteristic Hazardous Waste	536	4,375	40,906	1,766	2,345,484	1.673378E+09	934
Mixture Hazardous Waste	534	774	6,067	262	413,553	3.680955E+07	783
State Hazardous Waste	536	5,775	72,270	3,121	3,095,931	5.223027E+09	1,251
Total[1] Hazardous Waste	536	13,171	92,816	4,009	7,059,965	8.614913E+09	705
Hazardous Wastewater	536	1,336,340	19,336,632	835,215	716,278,579	3.739054E+14	1,446
Bevill Amendment Waste	533	147,388	2,091,667	90,600	78,558,205	4.375072E+12	1,419
Small Generator Waste	531	0.1	1.3	0.05	76	1.662495E+10	900
Non-Hazardous Process Waste	535	21,916	162,446	7,023	11,725,368	2.638896E+10	741

[1] Total hazardous waste is the sum of listed, characteristic, mixture, and state hazardous wastes.

TABLE 11A (continued)

(1982)

Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Listed Hazardous Waste	527	792	10,590	461	417,762	1.121627E+08	1,335
Characteristic Hazardous Waste	527	3,755	39,998	1,742	1,979,265	1.599900E+09	1,065
Mixture Hazardous Waste	527	572	4,425	192	301,692	1.958562E+07	773
State Hazardous Waste	527	4,309	58,159	2,533	2,271,206	3.382507E+09	1,349
Total[1] Hazardous Waste	528	9,412	71,411	3,107	4,969,925	5.099625E+09	760
Hazardous Wastewater	526	1,333,316	19,485,157	849,593	701,324,571	3.796714E+14	1,461
Bevill Amendment Waste	524	78,595	1,215,129	53,083	41,183,993	1.476539E+12	1,546
Small Generator Waste	523	0.17	1.39	0.06	90	1.939679E+00	809
Non-Hazardous Process Waste	527	19,822	159,566	6,950	10,446,634	2.546152E+10	804

[1] Total hazardous waste is the sum of listed, characteristic, mixture, and state hazardous wastes.

TABLE 12A

SUMMARY OF USE, REUSE, RECYCLE, AND RECLAIM PRACTICES (TONS) (1981)

	Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Direct Placement:	On-Site	535	0	0	0	0	0.000000E+00	
(Listed, Mixture,	Off-Site	535	0	0	0	0	0.000000E+00	
& State Hazardous)	Commercial	535	9	229	9	5,300	5.250467E+04	2,313
	Other	535	0	0	0	0	0.000000E+00	
	Total	536	9	228	9	5,300	5.240672E+04	2,315
Direct Placement:	On-Site	535	0	0	0	0	0.000000E+00	
(Characteristic)	Off-Site	535	0	0	0	0	0.000000E+00	
	Commercial	535	0	2	0	48	4.306542E+00	2,313
	Other	535	0	0	0	0	0.000000E+00	
	Total	536	0	2	0	48	4.298507E+00	2,315
Burned as Fuel:	On-Site	535	1,574	29,768	1,287	842,282	8.861682E+08	1,890
(Listed, Mixture,	Off-Site	535	1	15	0	546	2.280501E+02	1,479
& State Hazardous)	Commercial	535	20	310	13	10,906	9.644199E+04	1,523
	Other	535	3	64	2	1,778	4.136088E+03	1,935
	Total	536	1,596	29,742	1,284	855,512	8.846392E+08	1,863
Burned as Fuel:	On-Site	534	1,284	13,380	566	686,089	1.713645E+08	1,018
(Characteristic)	Off-Site	534	3	62	2	1,965	3.930211E+03	1,703
	Commercial	535	25	203	8	13,426	4.127076E+04	809
	Other	535	0.1	3	0.1	70	9.158879E+00	2,313
	Total	536	1,308	13,067	564	701,550	1.707571E+08	998
Reused as Raw:	On-Site	535	133	1,354	58	71,178	1.833490E+06	1,017
Process Material	Off-Site	535	3	46	1	1,951	2.134693E+03	1,266
(Listed, Mixture,	Commercial	535	5	60	2	2,917	3.685668E+03	1,113
& State Hazardous)	Other	535	0	0	0	0	0.000000E+00	
	Total	536	141	1,363	58	76,046	1.859600E+06	961

TABLE 12A (continued)

(1981)

Reused as Raw:	On-Site	535	469	4,568	197	251,117	2.087571E+07	973
Process Material	Off-Site	535	253	3,559	153	135,779	1.266810E+07	1,402
(Characteristic)	Commercial	535	110	2,065	89	59,033	4.266804E+06	1,872
	Other	535	0	0	0	0	0.000000E+00	
	Total	536	830	6,217	268	445,929	3.866035E+07	749
Treated &	On-Site	535	178	3,043	131	95,360	9.263493E+06	1,707
Reclaimed:	Off-Site	535	7	125	5	4,216	1.573923E+04	1,592
(Listed, Mixture,	Commercial	535	20	221	9	10,812	4.902981E+04	1,095
& State Hazardous)	Other	535	0	0	0	0	0.000000E+00	
	Total	535	206	3,056	132	110,388	9.340633E+06	1,481
Treated &	On-Site	535	566	6,814	294	303,206	4.643483E+07	1,202
Reclaimed:	Off-Site	535	0.2	0.4	0.2	10	1.869159E+01	2,313
(Characteristic)	Commercial	535	49	596	25	26,437	3.559080E+05	1,207
	Other	535	0	0	0	0	0.000000E+00	
	Total	536	614	6,829	295	329,653	4.664810E+07	1,110
Other:	On-Site	535	6	145	6	3,613	2.118781E+04	2,155
(Listed, Mixture,	Off-Site	535	0	0	0	0	0.000000E+00	
& State Hazardous)	Commercial	535	8	191	8	4,451	3.651665E+04	2,296
	Other	535	0	0	0	0	0.000000E+00	
	Total	535	15	239	10	8,064	5.759188E+04	1,592
Other:	On-Site	535	13,953	322,528	13,944	7,465,345	1.040249E+11	2,311
(Characteristic)	Off-Site	535	0	0	0	0	0.000000E+00	
	Commercial	535	12	195	8	6,444	3.819072E+04	1,622
	Other	536	3	77	3	1,792	5.991164E+03	2,315
	Total	536	13,943	322,304	13,921	7,473,581	1.038804E+11	2,311
Totals:	On-Site	536	32,030	456,353	19,711	9,718,190	2.082588E+11	1,424
	Off-Site	536	269	3,630	156	144,467	1.317885E+07	1,346
	Commercial	536	259	2,254	97	139,774	5.084911E+06	869
	Other	536	10	126	5	3,640	1.605039E+04	1,250
GRAND TOTAL:		536	32,559	456,450	19,715	10,006,071	2.083470E+11	1,401

TABLE 12A (continued)

(1982)

	Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Direct Placement:	On-Site	527	0	0	0	0	0.000000E+00	
(Listed, Mixture,	Off-Site	527	0	0	0	0	0.000000E+00	
& State Hazardous)	Commercial	527	8	200	8	4,609	4.027404E+04	2,294
	Other	527	0	0	0	0	0.000000E+00	
	Total	528	8	200	8	4,609	4.019776E+04	2,296
Direct Placement:	On-Site	526	0	0	0	0	0.000000E+00	
(Characteristic)	Off-Site	526	0	0	0	0	0.000000E+00	
	Commercial	526	1	24	1	635	5.846179E+02	2,002
	Other	526	0	0	0	0	0.000000E+00	
	Total	527	1	24	1	635	5.835093E+02	2,004
Burned as Fuel:	On-Site	527	249	1,867	81	131,273	3.487146E+06	749
(Listed, Mixture,	Off-Site	527	1	27	1	969	7.365310E+02	1,475
& State Hazardous)	Commercial	527	16	272	11	8,722	7.441173E+04	1,648
	Other	527	2	55	2	1,471	3.123192E+03	2,002
	Total	528	269	1,903	82	142,435	3.623134E+06	705
Burned as Fuel:	On-Site	525	1,075	12,170	531	564,524	1.481113E+08	1,131
(Characteristic)	Off-Site	526	2	53	2	1,239	2.848348E+03	2,265
	Commercial	525	21	184	8	11,296	3.412343E+04	858
	Other	526	3	66	2	1,583	4.472048E+03	2,222
	Total	526	1,100	12,160	530	578,642	1.478720E+08	1,105
Reused as Raw:	On-Site	527	134	1,368	59	70,783	1.872063E+06	1,018
Process Material	Off-Site	527	3	53	2	1,867	2.913602E+03	1,523
(Listed, Mixture,	Commercial	527	9	86	3	4,841	7.519216E+03	943
& State Hazardous)	Other	527	0.9	19	0.8	480	3.702715E+02	2,112
	Total	528	146	1,370	59	77,971	1.879295E+06	934

TABLE 12A (continued)

(1982)

Reused as Raw:	On-Site	526	442	4,125	179	232,718	1.701701E+07	932
Process Material	Off-Site	526	223	3,112	135	117,816	9.690596E+06	1,389
(Characteristic)	Commercial	524	66	1,179	51	34,839	1.390780E+06	1,773
	Other	526	0	0	0	0	0.000000E+00	
	Total	526	731	5,431	236	385,373	2.950381E+07	742
Treated &	On-Site	527	182	3,113	135	96,177	9.691920E+06	1,705
Reclaimed:	Off-Site	527	4	60	2	2,243	3.703913E+03	1,429
(Listed, Mixture,	Commercial	527	26	217	9	13,851	4.717202E+04	826
& State Hazardous)	Other	527	0.4	8	0.4	204	7.896774E+01	2,295
	Total	528	213	3,118	135	112,475	9.727715E+06	1,464
Treated &	On-Site	526	444	4,955	216	233,821	2.455427E+07	1,114
Reclaimed:	Off-Site	525	0.2	0.4	0	10	1.904762E-01	2,291
(Characteristic)	Commercial	526	66	773	33	35,142	5.978170E+05	1,157
	Other	526	0	0	0	0	0.000000E+00	
	Total	527	510	5,004	218	268,973	2.504549E+07	980
Other:	On-Site	526	6	131	5	3,225	1.722359E+04	2,120
(Listed, Mixture,	Off-Site	527	0	0	0	0	0.000000E+00	
& State Hazardous)	Commercial	527	0.9	1	0.5	45	1.515509E+00	1,441
	Other	527	0	0	0	0	0.000000E+00	
	Total	528	13	205	8	3,330	4.240097E+04	1,562
Other:	On-Site	526	16,226	262,748	11,456	8,534,999	6.903666E+10	1,619
(Characteristic)	Off-Site	526	0	0	0	0	0.000000E+00	
	Commercial	526	18	218	9	9,551	4.784446E+04	1,204
	Other	525	3	45	2	1,480	2.082114E+03	1,618
	Total	527	16,209	262,544	11,436	8,546,030	6.892948E+10	1,619
Totals:	On-Site	527	18,723	262,756	11,445	9,867,550	6.904091E+10	1,403
	Off-Site	527	235	3,138	136	124,144	9.852397E+06	1,332
	Commercial	527	207	1,457	63	123,531	2.125732E+06	703
	Other	527	8	98	4	5,218	9.683865E+03	1,094
GRAND TOTAL:		528	19,166	262,552	11,426	10,120,443	6.893375E+10	1,369

TABLE 13A

SUMMARY OF HAZARDOUS WASTE TREATMENT PRACTICES[1]
(TONS)

	Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
				1981				
Incineration:	On-Site	532	994	5,608	243	528,900	3.145582E+07	564
	Off-Site	533	22	288	12	11,953	8.314559E+04	1,285
	Commercial	533	100	368	15	53,7[illegible]9	1.359329E+05	365
	Total	535	1,113	5,656	244	594,602	3.199612E+07	508
Treatment:	On-Site	531	2,573	38,249	1,659	1,366,767	1.463011E+09	1,486
(Chemical,	Off-Site	532	13	267	11	6,916	7.138915E+04	2,055
Physical,	Commercial	532	130	1,337	57	69,388	1.788349E+06	1,025
Biological)	Total	533	2,707	38,192	1,654	1,443,071	1.458701E+09	1,410
Totals:	On-Site	536	3,536	38,893	1,679	1,895,667	1512681898	1,099
	Off-Site	536	35	391	16	18,869	152989	1,111
	Commercial	536	229	1,415	61	123,137	2004175	616
Grand Total:		536	3,801	38,933	1,681	2,037,673	1515803744	1,024
				1982				
Incineration	On-Site	523	782	4,708	205	409,107	2.217377E+07	601
	Off-Site	524	15	169	7	8,013	2.872121E+04	1,108
	Commercial	524	79	358	15	41,521	1.287864E+05	452
	Total	528	870	4,745	206	458,641	2.252159E+07	544
Treatment:	On-Site	522	2,285	37,647	1,647	1,193,289	1.417307E+09	1,646
(Chemical,	Off-Site	523	14	229	10	7,829	5.279630E+04	1,534
Physical,	Commercial	523	3,044	67,508	2,951	1,592,416	4.557363E+09	2,217
Biological)	Total	527	5,300	76,895	3,349	2,793,534	5.912898E+09	1,450
Totals:	On-Site	528	3,034	37,968	1,652	1,602,396	1441609480	1,251
	Off-Site	528	30	291	12	15,842	84762	970
	Commercial	528	3,094	67,185	2,923	1,633,937	4513933186	2,171
Grand Total:		528	6,159	77,061	3,353	3,252,175	5938461576	1,251

[1] Waste treatment quantities include state hazardous waste, but do not include hazardous wastewater.

TABLE 14A

SUMMARY OF HAZARDOUS WASTE DISPOSAL PRACTICES (TONS)
(1981)

	Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Landfill: (as-is tons)	On-Site	532	2,105	40,564	1,758	1,120,131	1.645515E+09	1,926
	Off-Site	533	31	434	18	17,021	1.885794E+05	1,359
	Commercial	533	757	5,615	243	403,287	31537162	742
	Total	536	2,873	40,762	1,760	1,540,439	1661621898	1,418
Landfill: (dry tons)	On-Site	524	2,051	40,817	1,783	1,075,080	1.666097E+09	1,989
	Off-Site	527	8	124	5	4,244	1.555931E+04	1,548
	Commercial	527	654	5,576	242	344,679	3.110259E+07	852
	Total	536	2,656	40,705	1,758	1,424,003	1656909174	1,532
*Surface Impoundment: (as-is tons)	On-Site	530	163			154,736		
	Off-Site	532	654			347,778		
	Commercial	533	17			8,829		
	Total	536	954			511,343		
*Surface Impoundment: (dry tons)	On-Site	529	49			26,041		
	Off-Site	529	7			3,650		
	Commercial	530	5			2,709		
	Total	536	60			32,400		
Waste Pile: (as-is tons)	On-Site	532	0	0	0	0	0.000000E+00	
	Off-Site	532	0	0	0	0	0.000000E+00	
	Commercial	532	0	0	0	0	0.000000E+00	
	Total	534	0	0	0	0	0.000000E+00	
Waste Pile: (dry tons)	On-Site	530	0	0	0	0	0.000000E+00	
	Off-Site	530	0	0	0	0	0.000000E+00	
	Commercial	530	0	0	0	0	0.000000E+00	
	Total	531	0	0	0	0	0.000000E+00	
Land Application: (as-is tons)	On-Site	532	0.8	14	0.6	432	2.016445E+02	1,748
	Off-Site	532	0	0	0	0	0.000000E+00	
	Commercial	532	47	1,097	47	25,305	1.203652E+06	2,306
	Total	534	48	1,095	47	25,737	1.199268E+06	2,272

* See Addendum Page:Note 4

TABLE 14A (continued)

(1981)

Land Application: (dry tons)	On-Site	529	0.6	13	0.6	300	1.701323E+02	2,300
	Off-Site	529	0	0	0	0	0.000000E+00	
	Commercial	529	6	140	6	3,239	1.983199E+04	2,300
	Total	529	6	141	6	3,539	1.999516E+04	2,113
Underground Injection: (as-is tons)	On-Site	533	7,371	72,505	3,140	3,929,114	5.257083E+09	983
	Off-Site	531	0	0	0	0	0.000000E+00	
	Commercial	531	186	1,554	67	99,133	2.417785E+06	832
	Total	535	7,529	72,382	3,129	4,028,247	5.239234E+09	961
Underground Injection: (dry tons)	On-Site	530	653	8,260	358	346,458	6.823295E+07	1,263
	Off-Site	529	0	0	0	0	0.000000E+00	
	Commercial	528	43	362	15	22,771	1.314333E+05	840
	Total	530	696	8,266	359	369,229	6.832702E+07	1,186
Ocean Dumping: (as-is tons)	On-Site	532	0	0	0	0	0.000000E+00	
	Off-Site	532	0	0	0	0	0.000000E+00	
	Commercial	532	67	1,560	67	36,000	2.436090E+06	2,306
	Total	534	67	1,557	67	36,000	2.426966E+06	2,310
Ocean Dumping: (dry tons)	On-Site	529	0	0	0	0	0.000000E+00	
	Off-Site	529	0	0	0	0	0.000000E+00	
	Commercial	529	0	0	0	0	0.000000E+00	
	Total	530	0	0	0	0	0.000000E+00	
Other:	On-Site	532	2,613	41,926	1,817	1,390,566	1.757807E+09	1,604
	Off-Site	532	0	0	0	0	0.000000E+00	
	Commercial	532	4	55	2	2,173	3.115686E+03	1,366
	Total	536	2,598	41,769	1,804	1,392,739	1744697297	1,607
*Total:	On-Site	536	12,304			6,594,979		
	Off-Site	536	681			364,799		
	Commercial	536	1,071			574,727		
Grand Total:		536	14,057			7,534,505		

* See Addendum Page:Note 4

TABLE 14A

SUMMARY OF HAZARDOUS WASTE DISPOSAL PRACTICES (TONS)
(1982)

	Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Landfill: (as-is tons)	On-Site	524	864	11,057	483	452,777	1.222739E+08	1,279
	Off-Site	524	19	278	12	10,417	7.767167E+04	1,401
	Commercial	525	627	4,465	194	329,267	1.993945E+07	711
	Total	528	1,500	11,842	515	792,461	140253665	789
Landfill: (dry tons)	On-Site	518	722	10,886	478	374,512	1.185169E+08	1,505
	Off-Site	519	6	85	3	3,204	7.293028E+03	1,383
	Commercial	517	391	3,457	152	202,411	1.195262E+07	883
	Total	518	1,130	11,402	500	585,726	1.300165E+08	1,008
Surface Impoundment: (as-is tons)	On-Site	523	219	2,700	118	114,679	7.294256E+06	1,231
	Off-Site	522	679	15,532	679	354,867	2.412463E+08	2,284
	Commercial	521	7	110	4	3,958	1.229218E+04	1,459
	Total	525	901	15,713	685	473,504	2.469160E+08	1,742
Surface Impoundment: (dry tons)	On-Site	520	34	459	20	17,943	2.113069E+05	1,332
	Off-Site	519	5	132	5	3,017	1.753813E+04	2,278
	Commercial	517	1	22	0.9	816	5.137560E+02	1,436
	Total	521	41	477	20	21,776	2.283575E+05	1,143
Waste Pile: (as-is tons)	On-Site	524	0	0	0	0	0.000000E+00	
	Off-Site	522	0	0	0	0	0.000000E+00	
	Commercial	522	0.01	0.2	0	6	6.896552E-02	2,284
	Total	527	0.01	0.2	0	6	6.831120E-02	2,295
Waste Pile: (dry tons)	On-Site	521	0	0	0	0	0.000000E+00	
	Off-Site	520	0	0	0	0	0.000000E+00	
	Commercial	520	0	0	0	0	0.000000E+00	
	Total	522	0	0	0	0	0.000000E+00	
Land Application: (as-is tons)	On-Site	524	0.6	13	0.6	337	1.742873E+02	2,052
	Off-Site	522	0	0	0	0	0.000000E+00	
	Commercial	522	0.5	11	0.5	252	1.216552E+02	2,284
	Total	527	1	17	0.7	589	2.931839E+02	1,532
Land Application: (dry tons)	On-Site	521	0.6	13	0.6	300	1.727447E+02	2,282
	Off-Site	520	0	0	0	0	0.000000E+00	
	Commercial	520	0	40	0	0	0.000000E+00	
	Total	522	0.6	13	0.6	300	1.724138E+02	2,284

TABLE 14A (continued)

(1982)

Underground	On-Site	524	6,497	67,994	2,970	3,404,778	4.623260E+09	1,046
Injection:	Off-Site	522	0	0	0	0	0.000000E+00	
(as-is tons)	Commercial	523	323	3,681	160	169,096	1.355128E+07	1,138
	Total	527	6,781	67,876	2,956	3,573,874	4.607206E+09	1,000
Underground	On-Site	521	514	7,399	324	267,822	5.475890E+07	1,439
Injection:	Off-Site	520	0	0	0	0	0.000000E+00	
(dry tons)	Commercial	521	26	197	8	13,867	3.888483E+04	740
	Total	521	540	7,401	324	281,691	5.478453E+07	1,368
Ocean Dumping:	On-Site	524	0	0	0	0	0.000000E+00	
(as-is tons)	Off-Site	522	0	0	0	0	0.000000E+00	
	Commercial	522	45	1,050	45	24,000	1.103448E+06	2,284
	Total	527	45	1,045	45	24,000	1.092979E+06	2,295
Ocean Dumping:	On-Site	521	0	0	0	0	0.000000E+00	
(dry tons)	Off-Site	520	0	0	0	0	0.000000E+00	
	Commercial	520	0	0	0	0	0.000000E+00	
	Total	523	0	0	0	0	0.000000E+00	
Other:	On-Site	524	1,540	24,314	1,062	806,992	5.912040E+08	1,578
	Off-Site	522	0	0	0	0	0.000000E+00	
	Commercial	522	5	65	2	2,617	4.275733E+03	1,304
	Total	528	1,533	24,222	1,054	809,609	586723632	1,579
Total:	On-Site	528	9,052	74,136	3,226	4,479,563	5496215888	818
	Off-Site	528	691	15,445	672	365,284	238555416	2,232
	Commercial	528	1,002	5,876	255	529,196	34538025	586
Grand Total:		528	10,746	75,811	3,299	5,674,043	5747422349	705

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TABLE 17A

SUMMARY OF HAZARDOUS WASTEWATER DISPOSAL (TONS)
(1981)

Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
NPDES Facility	534	1,117,430	19,272,031	83,3982	596,707,975	3.714112E+14	1,724
POTW Facility	536	7,3951	656,770	28,368	39,637,847	4.313473E+11	888
Deep Well Injection	535	34,767	281,001	12,148	18,600,677	7.896169E+10	808
Deep Well Dry Tons	532	1,996	17,372	753	1,062,209	3.018150E+08	870
Other	527	116,561	1,950,333	84,957	61,428,030	3.803800E+12	1,673

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TABLE 17A (continued)

SUMMARY OF HAZARDOUS WASTEWATER DISPOSAL (TONS)
(1982)

Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
NPDES Facility	525	1,114,348	19,416,084	847,387	585,032,763	3.769843E+14	1,742
POTW Facility	525	77,206	683,592	29,834	40,533,409	4.672991E+11	885
Deep Well Injection	526	34,798	276,304	12,047	18,303,865	7.634405E+10	794
Deep Well Dry Tons	526	1,536	12,985	566	808,359	1.686217E+08	844
Other	525	109,233	1,810,747	79,027	57,347,526	3.278805E+12	1,657

TABLE 18A

SUMMARY OF HAZARDOUS WASTE TREATMENT/DISPOSAL AND RECYCLING FROM OTHER SOURCES (TONS) (1981)

Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Treatment/Disposal:							
Company-Owned Source	534	264	4,825	208	141,372	2.328063E+07	1,822
Non-Company-Owned Source	534	309	5,858	253	165,178	3.432414E+07	1,894
Use, Reuse, Recycle, Reclaim:							
Company-Owned Source	534	309	5,751	248	165,150	3.307443E+07	1,859
Non-Company-Owned Source	534	1,250	17,240	746	667,964	2.972442E+08	1,378

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TABLE 18A (continued)

SUMMARY OF HAZARDOUS WASTE TREATMENT/DISPOSAL AND RECYCLING FROM OTHER SOURCES (TONS) (1982)

Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
Treatment/Disposal:							
Company-Owned Source	527	93	775	33	49,022	6.009305E+05	833
Non-Company-Owned Source	527	408	6,649	289	215,451	4.422082E+07	1,626
Use, Reuse, Recycle, Reclaim:							
Company-Owned Source	526	299	4,759	207	157,751	2.265450E+07	1,587
Non-Company-Owned Source	528	1,233	17,826	775	651,304	3.177906E+08	1,445

TABLE 19A

SUMMARY OF HAZARDOUS WASTE SHIPMENT METHODS[1]
(TONS)

Variable	N	Mean	Standard Deviation	Std Error of Mean	Sum	Variance	C.V.
1981							
Bulk Waste	532	1,248	5,702	247	664,224	3.251809E+07	456
Containerized Waste (<110 gallons)	533	168	970	42	90,011	9.425052E+05	574
				Total	754,235		
1982							
Bulk Waste	527	875	3,683	160	461,639	1.357181E+07	420
Containerized Waste (<110 gallons)	527	150	801	34	79,364	6.416543E+05	531
				Total	541,003		

1 The reported quantities include listed, characteristic, mixture, and state hazardous wastes.

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ADDENDA

Note 1 - After the final draft report had been completed it was discovered that one of the plants which participated in the pilot survey sent in a second set of questionnaires during the regular survey period. The second response was virtually the same as the first with some minor corrections. Therefore, the information from this plant was unknowingly entered into the data base twice. However, this does not represent "double counting" in the true sense. The data base bias is only to the degree by which this plant's responses differ from the observed mean values. Since this plant was a relatively large facility (in terms of total hazardous waste generated and disposed), many of the waste categories are biased by being larger than the true value. Although the large number of responses (N >500) aids in reducing the effect of this bias on both the actual and extrapolated values, the existence and effects of this data entry error should be considered when interpreting the survey results.

Note 2 - Some respondents erroneously reported hazardous wastewater in this category and again in response to Question 15C of the survey (see Table 17). This resulted in the disposal total being greater than the generation total for both 1981 and 1982 as well as double counting of some wastewater which was disposed of by underground injection. The resultant effect on the survey data is manifested as underground injection totals and waste disposal totals being somewhat (roughly ten percent) too high in each year.

Note 3 - Correspondence of respondents indicated that the "other" category was used primarily to report waste material which was disposed of in waste piles. Thus, to obtain a more accurate figure for the disposal of material in wastes piles, one should include the total of the "other" category.

Note 4 - After completion of the final draft report a keypunching error was detected in the "surface impoundment" category for 1981 only. The sum and mean values were adjusted to reflect the correct values; however, new dispersion parameters were not calculated. This also effected the dispersion parameters for the "total" categories, so they were not provided. However, it should be noted that the values in Table 14 of the text are the correct values for all waste disposal categories for both 1981 and 1982.